Nuclear Science Abstracts

A Publication on Atomic Energy
and Its Fields of

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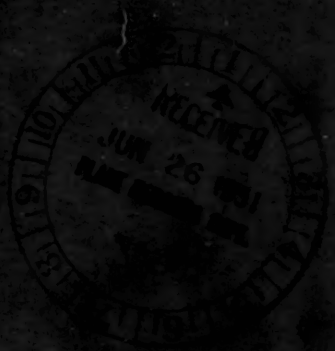

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About 175 bibliographies, government reports, and references from the literature are listed. Although a few of these articles have been abstracted in Nuclear Science Abstracts, it has not been the general policy to cover this field. Many additional abstracts related to civil defense may, however, be found in the categories "Atomic Bombs and Warfare" and "Radiation Hazards and Protection."

2636

[TYPES OF CONSTRUCTION WHICH MAY GIVE PROTECTION FROM THE EFFECTS OF AN ATOMIC EXPLOSION.] Charles Owen Brown. Ind. Eng. Chem. 43, 57A-58A, 60A(1951) Jan. (Equipment and design)

It is shown that structures are subjected to a blow from the right and then immediately subjected to one from the left following an atomic bomb explosion. The interior of the structure is subjected to increased pressure and then to negative pressure, and then the pressure becomes normal. Minor forces also act on the structure as the wave passes it. A weak, reflected wave is developed by the front of the building, and, as the main wave passes the building, eddy currents and reduced pressure areas develop back of the building for each passage of the main wave. Designs and types of construction of buildings are suggested for the protection of people and equipment and to preserve production facilities.

ATOMIC POWER

2637

ATOMIC ENERGY AND PATENT LAW. Theodore Hafner. J. Patent Office Soc. 33, 35-57(1951) Jan.

A review of the Atomic Energy Act, its history, and its operation is presented.

RESEARCH PROGRAMS

2638

Office of Naval Research, London
RESEARCH IN NUCLEAR AND THEORETICAL PHYSICS AT LUND, SWEDEN. Paul M. Marcus. Sept. 7, 1950. 6p. (ONRL-98-50)

A description is given of the work and facilities of the Department of Physics at the University of Lund, Sweden. The researches fall into three general categories: nuclear physics, theoretical physics, and atomic spectroscopy. Several special problems in the first two categories are briefly described, and a few general remarks are made about the third. Among the interesting researches are studies of cosmic rays by means of photographic emulsions and a new photoelectric orienting device to maintain the plates at constant angle with respect to the sun, a photoelectric method of automatic measurement of particle tracks in the photographic emulsion which gives good mass discrimination and avoids tedious grain counting, the application of NaI as a scintillation counter in high-speed counters, and the measurement of the electron charge by the shot effect. The theoretical physics department has specialized on quantum field theories, quantum electrodynamics, and the relations between scattering and interaction potentials. A method known as the analytic continuation method has been applied to the elimination of the divergencies in field theory. Calculations of interaction potentials from measurements in proton-proton scattering have been carried out, and various neutron-scattering problems are being studied. (auth)

BIOLOGY AND MEDICINE

2639

Peter Bent Brigham Hospital and Harvard Medical School
STUDIES ON LYSOZYME IN ULCERATIVE COLITIS. R. W. Reifenstein, S. J. Gray, E. P. Connolly, H. M. Spiro, and J. C. G. Young. [nd.] 18p. (AECU-1024)

A study was made of the effect of lysozyme inhibition on the course of the disease process, and an evaluation was made of fecal lysozyme titers in acute and chronic phases of the disease. Enzyme inhibition by Aerosol OT (di-octyl sodium sulfo succinate) is described.

2640

Argonne National Lab.
RATE AND EXTENT OF CITRATE FORMATION IN VIVO INDUCED BY NON-LETHAL DOSES OF FLUOROACETATE. Arthur Lindenbaum, Marcia R. White, and Jack Schubert. Oct. 1950. 16p. (AECU-1126; UAC-331)

The formation of citric acid in tissues of Sprague-Dawley rats following injection of single nonlethal doses of sodium monofluoroacetate (FA) has been studied, particularly in the spleen, heart, and kidney. The maximum nonlethal dose of FA was 1.0 mg/kg. The 10-day LD_{50} was about 1.5 mg/kg, and 2.0 mg/kg killed all rats. In the tissues studied, an induction period of 15 to 55 min preceded a sharp increase in citrate levels. The amount of citric acid accumulated in the tissues was proportional to the dose of FA, reaching a maximum at about 1.5 mg/kg. Higher doses of FA gave erratic results. Citrate concentrations of spleen, liver, and kidney reached a maximum at 4 to 6 hr following 0.48 or 0.75 mg of FA/kg and descended to control levels by 40 hr after injection. The rate of decrease of excess citrate varied with the tissue, whereas the time at which the peak citrate levels was reached was nearly independent of the tissue and the dose of FA. The effect of FA on citrate levels was unchanged in rats given a daily injection for 14 consecutive days. (auth)

2641

Brookhaven National Lab.
A TECHNIQUE FOR GROWING PLANTS UNDER STERILE CONDITIONS. Frank German and Vaughan T. Bowen. [nd.] 6p. (AECU-1136)

A technique is described for culture of plants on liquid organic nutrient media in sterile containers. This procedure has permitted raising an albino corn to a height of 30 cm with the same growth rate as that of control normal corn seedlings. (auth)

2642

Brookhaven National Lab.
THE RELATION OF THE MECHANISM OF ANTIBIOTIC ACTION TO STUDIES OF THE GENETICS OF STREPTOMYCIN RESISTANCE. B. A. Rubin, M. F. C. Perry, and F. Z. Thanassi. [nd.] 1p. (AECU-1144)

The report is reproduced here in its entirety.

Knowledge of the mechanism of streptomycin antibiosis provides a rapid method for quantitative (and qualitative) determination of drug-resistant mutants (Escherichia coli B/r) by a technique similar to that used for detection of phage resistance. The method depends, for greatest accuracy, on the rapid and complete killing of large numbers of nonmutants. When a streptomycin solution (in culture medium) is added to fully grown liquid cultures, only tubes containing mutants increase in turbidity. A simple Poisson calculation provides the mutation rate for rapidly detectable differences. Apparent variations in mutation rate appear which can be related to the characteristics of streptomycin action on dense bacterial cultures. At 20 μg/cc nonmutants grow normally, but at pH levels over 7.5 these cells eventually die, leaving only mutants. The addition of brain-heart extract suppresses the growth of the nonmutants under these conditions. At 200 μg/cc there is still growth of the nonmutants below pH 7, but these soon die. At 2000 μg/cc streptomycin activity loses all pH dependence, and only mutants grow. Although growth of nonmutants changes the apparent mutation rate, the extent of increase is less than would be expected from normal bacterial populations. Cytological observations show abnormal nuclear structure in nonmutants grown in streptomycin — possibly indicating interference with nucleic acid metabolism. The increased mutation rates in lower levels of streptomycin were attributable not only to growth differences but also to streptomycin sensitivity of some "resistant" mutants. Contrary to expectations a larger proportion of streptomycin-requiring mutants is found at lower concentrations of the drug.

2643

Brookhaven National Lab.
THE RECOVERY OF STREPTOMYCIN FROM CULTURES OF STREPTOMYCIN-REQUIRING MUTANTS OF ESCHERICHIA COLI. B. A. Rubin and P. Steinglass. [nd.] 1p. (AECU-1145)

The report is reproduced here in its entirety.

The various types of streptomycin-resistant mutants of E. coli interact in a manner suggesting interference with streptomycin utilization by the "requiring" mutants. This requirement for streptomycin has been related to the need of substitute mechanisms for pyruvate metabolism or nucleic acid synthesis. The growth of several mutants was found to vary in a complex manner with concentration of streptomycin and the nature of the medium. But in all cases, streptomycin could be recovered either by ultrafiltration or by centrifugation. Recovered material tested on the parent (sensitive) strain of E. coli and on Staphylococci, by cup plate and turbidimetric assays, showed drug concentrations equal to those found in sterile controls. Even when the streptomycin content of the requiring cultures was reduced to levels which limited the growth of a mutant, all the drug was recovered. In spite of supposed differences in permeability properties, different salts and brands of streptomycin supported the growth of "requiring" mutants to the same extent. Neither organic nor inorganic constituents of streptomycin fermentation liquor could be substituted for the drug. Concentrates of the vitamin B_{12} fraction of the fermentation failed completely to affect the growth of mutants. Streptomycin sulfate, inactivated to 3% of its antibiotic activity by hydroxylamine, showed no decrease in ability to support growth of requiring mutants. No utilization of streptomycin by any of the mutants tested could be demonstrated. The antibiotic quality of the drug is not identical with the property required for growth of streptomycin-requiring mutants; but no trace substance associated with streptomycin production seems involved in this effect.

2644

Argonne National Lab.
NOTE ON THE PREPARATION OF MOUSE TAILS FOR INTRAVENOUS INJECTION. Miriam Finkel, Gertrude Hirsch, and Ruth Bansch. Jan. 18, 1951. 9p. (ANL-4563)

The intravenous administration of solutions into mice is usually done by injection into one of the lateral tail veins. Customarily, a preinjection dilatation of the vessels is accomplished by bathing the tail in warm water. In recent

experiments many mice displayed tail lesions during the first 2 weeks that ranged from small areas of hyperemia at the injection site to necrosis and loss of the major portion of the tail. An experiment was done to test the hypothesis that the temperature of the bath was the damaging agent. A satisfactory 5-sec bath in water at 46°C produced no detectable injury during the following 11 days. The immediate results of a few seconds immersion in water at 60°C were severe hyperemia and occasionally the loss of skin. Spontaneous amputation of four-fifths of the tail occurred during the week following a 5-sec 60°C bath.

2645

Atomic Energy Project, Univ. of California, Los Angeles
CHANGES IN THE ELECTROLYTIC RESISTANCE OF BLOOD FOLLOWING COAGULATION AND CLOT RETRACTION. Thomas J. Haley and Frances Stolarsky. Feb. 9, 1951. 15p. (UCLA-110)

An instrument is described for the determination of blood-coagulation and clot-retraction times in which the results obtained are graphically recorded. It is shown that the blood-coagulation and clot-retraction times determined by the electrolytic resistance method are in agreement with those obtained by the usual clinical methods. The use of the electrolytic resistance measurement, because it is automatic, eliminates the human errors that are inherent in the present clinical methods. The theoretical physical-chemical changes occurring during blood coagulation and clot retraction are discussed. (auth)

2646

RECOVERY OF RADIOACTIVE IODINE FROM URINE. Alister Craig and Harold Jackson. Nature 167, 80-1(1951) Jan. 13. (Letter to the editor)

A simple process has been devised for the recovery of I^{131} from the urine of treated patients. A solution of normal $AgNO_3$ is added to the urine, and the precipitate is allowed to settle, after which the supernatant liquid is syphoned off and the residue is treated with an excess of Br_2. The Br_2 is boiled off, and the liquid is made ready for readministration by adjusting the pH and changing the iodate to iodide. In case a final purification is desired, a distillation method is presented which has proved very satisfactory with 95% or more efficiency.

RADIATION EFFECTS

2647

Atomic Energy Project, Univ. of Rochester
THE ACTIVATION OF LATENT BARTONELLOSIS IN THE RAT FOLLOWING INTRAVENOUS ADMINISTRATION OF POLONIUM. Mildred Carr, Helen Haydon, James K. Scott, and J. N. Stannard. Nov. 29, 1950. Decl. Jan 23, 1951. 18p. (AECD-3046; UR-145)

Following the intravenous administration of Po nitrate, latent bartonellosis was activated; the criteria for the occurrence of active disease were the presence of organisms in the red cells of the peripheral blood and anemia. Two experiments were performed: (1) a strain of rats not carrying the disease was compared with a strain known to harbor the infection, and (2) a group from the strain known to harbor the latent infection was compared with a group from the same strain which had been given mapharsen prior to the injection of Po. The animals in which the infection was activated by Po developed a more marked anemia than the control group; the survival time of those with an active infection was somewhat longer than in those without active infection. (auth)

2648

Brookhaven National Lab.
THE ADRENAL CORTICAL REQUIREMENTS OF ADRENALECTOMIZED, X-IRRADIATED RATS. Seymour Katsh and Abraham Edelmann. [nd.] 1p. (AECU-1134)

The report is reproduced here in its entirety.

Adrenalectomized male rats were maintained with whole-gland adrenal extract (Upjohn), the amount being adjusted so that the animals had a slight weight gain during the period of observation. The animals were irradiated with 600 r of x rays (160 kvp, 10 ma, 0.2 mm Cu). It was found that the level of cortical extract had to be increased several fold for 3 to 4 days after irradiation to inhibit weight loss. A gradual reduction in extract requirement then occurred, basal levels being reached after 5 days. This clearly indicates the need of the animal for increased adrenal hormones following x irradiation.

2649

Brookhaven National Lab.
THE EFFECTS OF X-RAYS ON DESOXYPENTOSE NUCLEIC ACID IN SITU; QUANTITATIVE CYTOCHEMICAL STUDIES ON TRILLIUM. M. J. Moses, R. DuBow, and A. H. Sparrow. [nd.] 1p. (AECU-1162)

The report is reproduced here in its entirety.

X rays are known to reduce the viscosity of solutions of desoxypentose nucleic acid (DNA). This has been interpreted as a depolymerization of the DNA molecule. However, this effect has only been observed on extracted DNA, and it is not known that depolymerization actually occurs in the intact cell. Such evidence has been sought cytochemically, utilizing quantitatively the methyl green reaction for polymerized DNA and the Feulgen reaction for total DNA. Moreover, a modification of the latter reaction involving prolonged 1N HCl hydrolysis measures the rate at which acid degradation occurs and yields further information on the state of the molecule. Living buds of Trillium erectum undergoing meiosis were irradiated at 50, 200, and 20,000 r, the latter dose being sufficient to markedly reduce viscosity of DNA solutions. Methyl green and Feulgen reactions were carried out on sections of the Carnoy-fixed anthers. Microphotometric measurements were made of the dye content of pollen mother cell nuclei. In no case did irradiation produce the anticipated decrease in methyl green content. In one experiment, pachytene nuclei, irradiated at 20,000 r showed a 20% increase in methyl green content over controls. The Feulgen reaction (optimal hydrolysis) was not affected, indicating no change in total DNA. However, the degradation of DNA (loss of thymic acid) through prolonged hydrolysis was markedly inhibited after heavy irradiation. From the methyl green results it cannot properly be said that de-

polymerization of DNA, such as is caused by treatment with hot water or the enzyme DNase, has been induced by irradiation. Indeed, it would seem that the net result has been to increase the stability of the DNA molecule rather than to decrease it.

2650

Brookhaven National Lab.
ADRENAL SHIELDING AND SURVIVAL OF RATS AFTER X-IRRADIATION. Abraham Edelmann. [nd.] 14p. (AECU-1192)

Lead shields placed around the adrenal glands of rats appreciably decreased the number of deaths following 700 or 800 r of whole-body x radiation. It is thought that the shielding prevents direct radiation damage to the glandular cells so that they retain their ability to respond to nonspecific stress. The gland became extruded from the shield by 3 months, probably because of the formation of connective tissue within the shield. Enucleation with degeneration of the medulla appeared to result. It is thought that available histological and histochemical techniques do not reveal the true radiosensitivity of the adrenal cortex.

2651

Atomic Energy Project, Univ. of California, Los Angeles
THE INABILITY OF THIOUREA TO MODIFY ROENTGEN RAY IRRADIATION MORTALITY IN RATS. Thomas J. Haley, Samuel Mann, and Andrew H. Dowdy. Feb. 16, 1951. 7p. (ULCA-112)

The hypothyroid state induced by feeding 0.1% thiourea confers no protection on rats subjected to 600 r of acute whole-body roentgen irradiation. Hyperthyroidism produced by thyroxin injections results in a slight increase in the rate of mortality under the same experimental conditions. However, the greatest increase in the rate of mortality was seen in those animals which had been treated with both thiourea and thyroxin. (auth)

2652

THE INFLUENCE OF X-RAYS; chap. VII of DIELECTRIC DETERMINATIONS OF MOLECULAR WEIGHT AND DIPOLE MOMENT OF SODIUM THYMONUCLEATE. Ingmar Jungner. Acta Physiol. Scand. 20, Suppl. 69, 72-7 (1950).

Studies of x-irradiated aqueous solutions of the sodium salt of desoxyribonucleic acid (DNA) show that x rays have mainly a depolymerizing effect. Only after very large doses (>100,000 r to a 0.05% solution) does the specific polarity fall considerably, whereas the molecular weight remains relatively constant at about 30,000. The effect of the x rays on stronger concentrations of DNA (0.625%) is smaller, but essentially similar. No aftereffect of the x rays on the dielectric properties can be noted within 12 to 48 hr of irradiation. (auth)

2653

Naval Radiological Defense Lab.
THE SUSCEPTIBILITY OF IRRADIATED MICE TO INFECTION AS A FUNCTION OF POST-IRRADIATION TIME. I. L. Shechmeister, V. P. Bond, and M. N. Swift. Dec. 12, 1950. 22p. (AD-279(B))

The susceptibility of mice to airborne Streptococcus zooepidemicus was determined over a 50-day period following 350 r of whole-body x irradiation. Bacterial LD_{50} values were determined for normal and irradiated mice on 12 different postirradiation days during this period, and the changes in susceptibility in each case were expressed as the ratio of the two. The resulting curve relating susceptibility to postirradiation time indicated that there was a linear increase in susceptibility over the first 15 days, which reached a peak five times that of controls. This was followed by an exponential drop which approached the control level shortly after 30 days. The possible relationship of this phenomenon to other radiation effects is discussed. (auth)

RADIATION HAZARDS AND PROTECTION

2654

Brookhaven National Lab.
PROGRESS REPORT ON WASTE CONCENTRATION STUDIES; IV. DESCRIPTION OF AND PRELIMINARY TESTS ON THE BNL-MODIFIED CLEAVER-BROOKS DVC-8E VAPOR COMPRESSION STILL. R. V. Horrigan. Jan. 8, 1951. 18p. (BNL-92)

The purpose of this report is to describe the BNL-modified Cleaver-Brooks DVC-8E Compression Distillation Still, with its accessories, modifications, and instrumentation. In an appendix are given the timetable of delivery, installation, and acceptance tests; typical startup, operating, and shutdown procedures; precautions to be observed when handling radioactive materials; and typical sampling and analytical techniques. This report summarizes all work done on the experimental unit previous to the start of "hot" runs. (auth)

2655

Kellex Corp.
PROGRESS REPORT; FOURTH QUARTER, 1950; DEVELOPMENT OF LABORATORY DISPOSAL UNIT; JOB-24-A. Jan. 30, 1951. 15p. (KLX-1330)

Work on the development of a laboratory ion-exchange unit for the decontamination of radioactive-waste solutions has been started. The following desirable specifications have been developed: (1) the unit should be designed for dilute feeds with activities in the range of 1000 to 2000 cpm/ml, (2) the disposable cartridge should be completely combustible, and (3) an adsorbent volume of about ¼ cu ft is desired. An equal-volume mixture of anionic and cationic resins pretreated with HCl was tentatively selected as the adsorbent. Tests were carried out with representative individual isotopes to determine the adsorbing capacity of this mixture as a function of the total concentration of salts in the feed solutions. When the only salts present are those contained in the Oak Ridge tracer solutions, a cubic foot of resin will process thousands of gallons of these solutions. Using ordinary neutral salt concentrations of 0.1%, the decontaminating capacity of the mixed resin is about 600 to 1000 gal of waste solution per cubic foot of resin. At higher

salt concentrations, the volume of liquid treated prior to break-through is approximately inversely proportional to the salt content. In experiments using a Cs tracer, free NaOH in concentrations of 0.1 to 0.5% decreases the adsorbing capacity of the resin, and free HCl in concentrations of 0.1 to 0.5% increases the adsorbing capacity. Ru, Zr, Mo, and Fe are more difficultly adsorbed and are being investigated in greater detail in current tests. A number of alternative mechanical designs of a prototype unit has been developed, and after further study the most desirable of these will be submitted for construction approval.

2656

Health and Safety Division, NYO, AEC
COVERALL SHIELDING TO BETA RADIATION. Sam A. Rothenberg. Feb. 13, 1951. 4p. (NYO-1543)

To determine the shielding afforded against β radiation from U by coveralls worn in U-processing plants, coveralls which were similar to those commonly worn at all U plants were tested. They are composed of olive-drab denim, winter weight (9 oz/sq yd), and are constructed in such a manner as to offer different degrees of shielding for different parts of the garment, since the cloth is hemmed and belted at different points. The coveralls showed a β absorption of 11.4% (σ 0.92) for one layer of cloth and 21.7% (σ 1.16) for two layers.

2657

PRECAST CONCRETE OFFERS PROTECTION AGAINST ATOMIC BLAST. Arsham Amirikian. J. Am. Concrete Inst. 22, 497-516(1951) Mar.

Precast concrete is reported as an excellent means for providing protection against an atomic blast. The technique is indicated as suitable for new construction and is adaptable to existing structures by providing them with a protective shell. Readily assembled framing elements can be prefabricated at regional plants and stored or stockpiled at various points for immediate use in an emergency. For design purposes, in this paper, shelters are divided into three groups in relation to their proximity to a probable target. Suggested arrangements and main details of assembly of a number of types of precast framing suitable for each group are presented. A general discussion of the protection problem, the needed weapons data, and design criteria are also given. (auth)

RADIOGRAPHY

2658

Naval School of Aviation Medicine, Pensacola
QUANTITATIVE RADIOAUTOGRAPHY USING RADIOACTIVE MONOLAYERS AS STANDARDS. Dietrich E. Beischer. May 26, 1950. 10p. (NP-1994)

Quantitative radioautography can be made more accurate by exposing a standard source with multiple intensities for the same time and to the same photographic emulsion as the specimen. The absolute radioactive reference source can be made of several active monolayers. The activity of the specimen in areas as small as 30 μ can be measured by means of a microdensitometer comparing the densities of each specimen's radioautograph with the calibration curve furnished by the standard source. (auth)

RADIOTHERAPY

2659

SOME OBSERVATIONS AND PROBLEMS OF TREATMENT WITH RADIOACTIVE IODINE I^{131}. G. F. Green, J. F. Tait, and R. Worsnop. Brit. J. Radiology 24, 148-55(1951) Mar.

A clinical report is presented of a case of carcinoma of the thyroid with metastases, treated by using tracer doses of I^{131}. Problems which may arise in this method of treatment are discussed, together with some conclusions which may be drawn from a study of the physical data.

2660

TITRATED, REGULARLY SPACED RADIOACTIVE PHOSPHORUS OR SPRAY ROENTGEN THERAPY OF LEUKEMIAS. Edwin E. Osgood. Arch. Internal Med. 87, 329-48(1951) Mar.

The method of titrated, regularly spaced, total-body irradiation for the treatment of the chronic leukemias is described. Every previously untreated patient with chronic leukemic granulocytic or chronic leukemia lymphocytic referred between 1941 apd Dec. 30, 1949, was treated by this method and is reported in this paper. The exact status of every patient started on this therapy is known. The data presented include death and disability from all causes. Of 58 patients (20 with chronic leukemic granulocytic leukemia ranging in age from 3 to 71 yr and 38 with chronic leukemic lymphocytic leukemia ranging in age from 27 to 81 yr), 32 are living at the time of this report. The mean duration of life from onset of the disease is 3.6 yr for the total series, 4.0 yr for those with granulocytic leukemias, and 3.4 yr for those with lymphocytic leukemia, of whom 18 were first seen since Jan. 1, 1949. More than 80% of the total 208 yr of leukemic life in this series of patients has been spent in essentially normal living. These results appear to justify comparative trial of the method by other investigators.

2661

THE TREATMENT OF POLYCYTHEMIA VERA WITH RADIOACTIVE PHOSPHORUS. Bruce K. Wiseman, Robert J. Rohn, Bertha Bouroncle, and William G. Myers. Ann. Internal Med. 34, 311-30(1951) Feb.

A report is presented concerning experience with P^{32} in the treatment of 108 cases of polycythemia vera extending over a period of almost 10 yr, contrasted with an almost equal period of observation during which time 30 cases of this disease were treated by conventional methods. Basic principles of internal-radiation therapy with radiophosphate in the treatment of polycythemia vera are listed, and a standardized method of treatment is set up. Effects of P^{32} therapy on symptoms and on physical signs, and causes of death in 453 P^{32}-treated cases are reported. Graphic data on single cases are included.

TOXICOLOGY STUDIES

2662

BERYLLIUM DAMAGE TO THE LUNGS AND BASES FOR ITS APPRAISAL. H. Gartner. Munch. med. Wochschr. 92, 970-4 (1950) Sept. 15. (In German)

The tolerance concentration of Be, the nature of acute and of chronic, delayed Be lung damage, and the difficulties of prognosis are reviewed. 27 references.

TRACER APPLICATIONS

2663

Wesleyan Univ. and Brookhaven National Lab.
THE METABOLISM OF SPECIES OF STREPTOMYCES; IV. THE EFFECT OF SUBSTRATE ON THE ENDOGENOUS RESPIRATION OF S. COELICOLOR. Vincent W. Cochrane and Martin Gibbs. [nd.] 6p. (AECU-1084)

When cells of Streptomyces coelicolor are grown in a medium containing glucose uniformly labeled with C^{14}, addition of a respirable substrate such as glucose or pyruvate does not appreciably suppress endogenous CO_2 production, as judged by the total radioactivity of respired CO_2. Consequently, in manometric experiments with exogenous substrate, subtraction of endogenous values is permissible. (auth)

2664

Brookhaven National Lab. and Indiana Univ.
A NEW MECHANISM OF ETHANOL FORMATION IN THE HETEROLACTIC FERMENTATION. Martin Gibbs and R. D. DeMoss. [nd.] 1p. (AECU-1131)

The report is reproduced here in its entirety.

Fermentation of glucose by the heterofermentative coccus Leuconostoc mesenteroides yields lactate, ethanol, and CO_2 in equimolar ratio. The rate is increased by acid reaction or by added acetate, acetaldehyde, acetoin, or diacetyl. Dried-cell preparations produce 1 mole of lactate per mole of glucose, or HDP only, therefore accounting for but one-half the carbon of the substrate. Cell-free extracts contain aldolase and DPN-linked dehydrogenases for triose phosphate, lactate, ethanol, acetoin, and butylene glycol. These experiments indicate (1) formation of lactate via the usual Meyerhof-Embden scheme, (2) lack of mixing of carbon skeletons at the triose stage, and (3) formation of ethanol and CO_2 by an undisclosed mechanism. To test these possibilities C^{14} glucose was fermented with cell suspensions, using conditions which yield the products indicated. Glucose-1-C^{14} yielded $C^{14}O_2$, ethanol with a trace of C^{14}, and unlabeled lactate. Glucose-3,4-C^{14} yielded half the C^{14} in the carboxyl of lactate, and half in the carbinol of ethanol, with a trace in the CO_2. With a mixture of carboxyl-labeled acetate and unlabeled glucose, C^{14} was found exclusively in the carbinol of ethanol. Thus the isotope experiments confirm the conclusion that a new pathway for ethanol formation exists.

2665

Brookhaven National Lab.
DISAPPEARANCE FROM MOUSE TISSUES OF CARBON FROM ASSIMILATED SUCROSE. Robert Steele. [nd.] 1p. (AECU-1133)

The report is reproduced here in its entirety.

Ten male mice, C57 blacks, 3½ to 6½ months old, were each fed a single dose of uniformly enriched C^{14}-sucrose. Total sucrose fed was 5.0 to 8.3 mg/g mouse body weight. Stock mouse pellet diet preceded and followed the dose. At various times from 3½ hr to 36 days after C^{14}-sucrose ingestion, mice were killed by withdrawing heart blood under Nembutal anesthesia and were dissected immediately. Dissected parts were powdered at liquid-nitrogen temperature, and portions were subjected to combustion. The resulting CO_2 was counted as $BaCO_3$. Specific activity was expressed in millimicrocuries per milligram of tissue carbon for 1 μc of C^{14} fed per gram of mouse body weight. For the carbon of each of 31 organs or tissues, the logarithm of the specific activity was plotted against elapsed time. Each curie was resolved into as many straight-line components as necessary for its description. Organs concerned with alimentation required four-component description, most other organs required three. The organic carbon of the solid portion of long bone has a component with a half-life of about 200 days. The 3½-hr concentration of this component is about 0.05 mμc/mg of carbon for 1 μc of C^{14} sucrose fed per gram of mouse body weight. Abdominal storage fat has a very low turnover rate as measured by this method. Throughout the 36 days its C^{14} concentration remained about 0.12 mμc/mg carbon for 1 μc of C^{14} sucrose fed per gram of mouse body weight.

2666

Brookhaven National Lab.
BROOKHAVEN CONFERENCE REPORT; CO_2 ASSIMILATION REACTIONS IN BIOLOGICAL SYSTEMS; JUNE 7–8, 1950. Dec. 1950. 149p. (BNL-70)

Separate abstracts have been prepared on the following sections of this report: Comments on CO_2 Fixation in Biochemistry, p.1-15; Biosynthesis of Dicarboxylic and Tricarboxylic Acids by CO_2 Fixation, p.16-36; The Mechanism of the Fixation of Carbon Dioxide in Dicarboxylic Acids, p.37-55; Organic Acid Synthesis by C_2 Condensation, and Reversible CO_2 Exchange Reactions, 56-63; β-Carboxylases and Related Enzymes in the Tissues of Higher Plants, p.64-76; The Role of the Organic Acids in Photosynthesis, p.77-96; Metabolism of Soybean Leaves. I. On the Sequence of Formation of the Soluble Carbohydrates During Photosynthesis, p.97-110; Metabolism of Soybean Leaves. II. Amino Acids Formed During Short-Term Photosynthesis, p. 111-18; Carboxylation Reactions of Photosynthesis, p.119-38; and The Metabolism of $C^{14}O_2$ by Sunflower Leaves, p.139-45.

2667

Western Reserve Univ.
COMMENTS ON CO_2 FIXATION IN BIOCHEMISTRY; p.1-15 of BROOKHAVEN CONFERENCE REPORT; CO_2 ASSIMILATION REACTIONS IN BIOLOGICAL SYSTEMS; JUNE 7–8, 1950. Harland G. Wood. Dec. 1950. 15p. (BNL-70 (p.1-15))

General comments and anecdotes on early considerations of CO_2 fixation in biochemistry are related. Primary fixation reactions are discussed including a reference to the question of primary fixation of CO_2 in the α carboxyls.

Examples include reactions with a cell-free extract from Clostridium butylicum, a phosphoroclastic reaction occurring in E. coli, and a dismutation reaction with Staphylococcus. CO_2 fixation in the methyl and carboxyl groups of acetic acid is also discussed with reference to appropriate examples. Utilization of the mass spectrometer for the study of reaction mechanisms in a different manner than is usually employed in biochemistry is indicated. 35 references.

2668

New York Univ. Coll. of Medicine
BIOSYNTHESIS OF DICARBOXYLIC AND TRICARBOXYLIC ACIDS BY CARBON DIOXIDE FIXATION; p.16-36 of BROOKHAVEN CONFERENCE REPORT; CO_2 ASSIMILATION REACTIONS IN BIOLOGICAL SYSTEMS; JUNE 7-8, 1950. Severo Ochoa. Dec. 1950. 21p. (BNL-70(p.16-36))

Following brief historical references, a review is presented of studies on the enzymatic mechanisms of synthesis of dicarboxylic and tricarboxylic acids by CO_2 fixation carried out at Brookhaven National Laboratory during the past few years. Interaction between dicarboxylic and tricarboxylic systems, based on a consideration of the reactions catalyzed by the isocitric enzyme and by the "malic" enzyme of pigeon liver, is said to suggest the following reversible reactions: d-isocitrate + pyruvate + CO_2 $\xrightleftharpoons{(TPN, Mn^{++})}$ α-ketoglutarate + CO_2 + l-malate, where TPN = triphosphopyridine nucleotide. Further discussion of the distribution and biological function of isocitric and malic enzymes is included. 42 references.

2669

Western Reserve Univ.
THE MECHANISM OF THE FIXATION OF CARBON DIOXIDE IN DICARBOXYLIC ACIDS; p.37-55 of BROOKHAVEN CONFERENCE REPORT; CO_2 ASSIMILATION REACTIONS IN BIOLOGICAL SYSTEMS; JUNE 7-8, 1950. M. F. Utter. Dec. 1950. 19p. (BNL-70(p.37-55))

Evidence has been presented on the following points. ATP (adenosine triphosphate) probably acts directly in the CO_2-fixation reaction in oxalacetate by pigeon-liver preparations. ATP directs the fixation of CO_2 toward oxalacetate, and TPN (triphosphopyridine nucleotide) directs it toward malate when both acids are present. There is some evidence that both these reactions proceed from a common precursor. By studies of the correlation of the fixation of CO_2 and pyruvate in oxalacetate, it seems probable that neither of these substances, as such, is a direct precursor of oxalacetate, although the precursors are ill-defined and may be enzyme complexes with those substances. 11 references.

2670

Oak Ridge National Lab.
ORGANIC ACID SYNTHESIS BY C_2 CONDENSATION, AND REVERSIBLE CO_2 EXCHANGE REACTIONS; p.56-63 of BROOKHAVEN CONFERENCE REPORT; CO_2 ASSIMILATION REACTIONS IN BIOLOGICAL SYSTEMS; JUNE 7-8, 1950. S. F. Carson. Dec. 1950. 8p. (BNL-70(p.56-63))

The main reactions of the C_4 respiratory cycle had been suggested nearly 30 years ago but without experimental proof. Since that time evidence has accumulated for some of the steps. Data presented afford the means of closing one, if not all, of the gaps relative to a C_3-C_4 respiratory cycle. The demonstration of a direct oxidative pathway from C_3 to C_4 is indicated as being important in several respects. First, it differs greatly in a thermodynamic sense; the reaction $C_3 + CO_2 \rightarrow C_4$ requires energy transfer from other oxidations in order to shift the equilibrium in the direction of C_4 synthesis, whereas the reaction $C_3 + C_3 \rightarrow C_4$ probably not only does not require input of energy but may be exergonic. Secondly, this reaction affords autotrophic plant life a direct route to the important C_4 and C_6 acids which does not involve the vast amounts of typical carbohydrate split-products. Experiments on CO_2 exchange with carboxyls of preformed (by a synthesis independent of CO_2 fixation) C_4 acids demonstrate that it is necessary to interpret with reserve the mechanism involved in synthesis of carboxyl-labeled C_4 dicarboxylic acids. The mere finding of carboxyl activity does not necessarily prove that the mode of net synthesis was via a $C_3 + CO_2$ reaction. 12 references.

2671

Chicago Univ.
β-CARBOXYLASES AND RELATED ENZYMES IN THE TISSUES OF HIGHER PLANTS; p.64-76 of BROOKHAVEN CONFERENCE REPORT; CO_2 ASSIMILATION REACTIONS IN BIOLOGICAL SYSTEMS; JUNE 7-8, 1950. Eric E. Conn and Birgit Vennesland. Dec. 1950. 13p. (BNL-70(p.64-76))

This work has shown that enzymes which catalyze the decarboxylation of oxalacetate and oxalsuccinate are found in higher plants. In the case of oxalacetate carboxylase, which has been studied more extensively, the distribution is wide. The TPN- (triphosphopyridine nucleotide) specific enzyme which catalyzes the oxidative decarboxylation of malate to pyruvic acid and CO_2 has also been found widely distributed in plant tissues. The occurrence in wheat and other plants of an enzyme which oxidizes the reduced pyridine nucleotides and an enzyme which splits TPN at the pyrophosphate bond is reported. A study of the partly purified wheat germ oxalacetate carboxylase has shown that there are certain differences in properties between the plant and pigeon-liver enzymes. First, the kinetics are different. Second, the divalent cation required for enzymic activity is reported to be much less firmly bound to the plant carboxylase than the animal enzyme. Even though the β-carboxylases of plants do differ somewhat from the animal enzymes, the available evidence supports the belief that the process of CO_2 assimilation by enzymes from these two sources is similar in outline if not in detail. 16 references.

2672

Argonne National Lab., and Wisconsin Univ.
THE ROLE OF THE ORGANIC ACIDS IN PHOTOSYNTHESIS; p.77-96 of BROOKHAVEN CONFERENCE REPORT; CO_2 ASSIMILATION REACTIONS IN BIOLOGICAL SYSTEMS; JUNE 7-8, 1950. Robert E. Stutz. Dec. 1950. 20p. (BNL-70(p.77-96))

Initial experiments with Bryophyllum calycinum indicated an accumulation of C^{14} in malic acid. This was also true when tobacco, tomato, and barley plants were given $C^{14}O_2$ for 30 min in light; it was generally true when these plants were

permitted to fix $C^{14}O_2$ in the dark for 15 min after preillumination. This latter group of experiments was intended to give evidence of the nature of the first products of photosynthesis. Although this suggested that malic acid occupied a key position as an early product of photosynthesis, several lines of evidence indicate that it is several steps removed from the initial photosynthetic processes. First, malic acid appears to function as a preferential reservoir of newly reduced carbon which is moving into the tricarboxylic acid cycle. This is particularly borne out in the 15-min dark-fixation experiment with tobacco. Second, malic acid was active in picking up C^{14} during the respiratory-fixation experiments. Third, at the end of a 4-hr dark-interconversion period, the activities of the acids, including malic, had generally increased, indicating the presence of a precursor of higher activity which would donate activity to the acids during the dark period. Qualitative studies of the role of the amino acids were made using paper chromatography, which indicated that serine, alanine, glycine, and aspartic acid picked up activity more rapidly than did the other amino acids. Although the shift in activity to glutamic acid and the amides did not follow the shift in the organic acids during the dark period of the interconversion experiments, Krebs-cycle activity was indicated. Several biosynthetic experiments were also carried out which indicated the feasibility of obtaining 100-mg quantities of active isocitric acid from Bryophyllum calycinum and very active acids from tobacco seedlings in single separations on silica gel columns. 12 references. (auth)

2673

Iowa State Coll.
METABOLISM OF SOYBEAN LEAVES; I. ON THE SEQUENCE OF FORMATION OF THE SOLUBLE CARBOHYDRATES DURING PHOTOSYNTHESIS; p.97-110 of BROOKHAVEN CONFERENCE REPORT; CO_2 ASSIMILATION REACTIONS IN BIOLOGICAL SYSTEMS; JUNE 7-8, 1950. S. Aronoff and L. Vernon. Dec. 1950. 14p. (BNL-70 (p.97-110))

By means of C^{14}-labeled CO_2, it has been shown that, under conditions of light saturation, the sequence of formation of carbohydrates in young soybean leaves is: trioses and glucose (trioses probably first), followed by sucrose, and then by raffinose and mannose. Under all conditions, the free hexoses and those obtained from the disaccharides are composed of two equal halves. Because of a nonuniformity of radioactivity within each half of the glucose, that compound must have been derived from two 3-carbon units, probably the trioses. Fructose from hydrolyzed sucrose shows almost uniform distribution at all times, whereas glucose from the same moiety does not. The glucose portion of the sucrose is formed prior to the fructose. The formation of sucrose thus appears to follow a different pathway from that of glucose. A rapid method is presented for the determination of the distribution of activity within the hexose molecule; it is applicable to those polysaccharides that yield hexoses on hydrolysis. 19 references (auth)

2674

Iowa State Coll.
METABOLISM OF SOYBEAN LEAVES; II. AMINO ACIDS FORMED DURING SHORT-TERM PHOTOSYNTHESIS; p. 111-18 of BROOKHAVEN CONFERENCE REPORT; CO_2 ASSIMILATION REACTIONS IN BIOLOGICAL SYSTEMS; JUNE 7-8, 1950. L. P. Vernon and S. Aronoff. Dec. 1950. 8p. (BNL-70(p.111-18))

Amino acids found to contain radioactivity from $C^{14}O_2$ in 15- and 50-sec photosynthetic periods are, in order of decreasing specific and total activity, alanine, serine, and glycine. Chemical methods for the determination of the distribution of activity within the listed amino acids are reported. Glycine has a slightly higher activity in the C_2 position in 15-sec photosynthesis, becoming essentially equal in the 50-sec photosynthesis. Both alanine and serine have higher activity in the C_1 position, with the C_2 and C_3 positions being equal. Alanine contains the highest percentage of activity in the C_1 position. Alanine is assumed to be directly connected to the main photosynthetic reaction chain, whereas both serine and glycine derive their activity by more circuitous routes. Alanine and serine arise from the addition of $C^{14}O_2$ to some 2-carbon compound of equal activity distribution. The origin of the 2-carbon compound, is unknown since neither 4-carbon organic acids, nor even aspartic acid or asparagin, have been found in the time periods studied. (auth)

2675

Radiation Lab., Univ. of California
CARBOXYLATION REACTIONS OF PHOTOSYNTHESIS; p.119-38 of BROOKHAVEN CONFERENCE REPORT; CO_2 ASSIMILATION REACTIONS IN BIOLOGICAL SYSTEMS; JUNE 7-8, 1950. A. A. Benson. Dec. 1950. 20p. (BNL-70(p.119-38))

CO_2 fixation in plants requires no simultaneous photochemical step and has been shown to be incorporated via two major carboxylation reactions, $C_1 + C_2$ and $C_1 + C_3$. For conditions of high light intensity, the $C_1 + C_2$ carboxylation predominates, but at very low intensity, the $C_1 + C_3$ carboxylation is a major reaction. It is postulated that the C_2-CO_2 acceptor of photosynthesis is derived from a C_4 dicarboxylic acid which has been shown not to be malic acid. When plants are illuminated in the absence of CO_2, glycolic acid and glycine accumulate. It is suggested that glycolic acid is related to the C_2 acceptor of photosynthesis. Glycolic acid appears subsequent to phosphoglyceric acid in photosynthesis. It is invariably found to be uniformly labeled. Glyceric acid formed in short photosynthesis has equally labeled α and β carbon atoms. The hexose and glycolic acid distributions of radioactivity are similar. This implies that a symmetrical 2-carbon precursor of phosphoglycerate may exist. The radioactivity distributions, identity, and sequence of intermediates involved in sucrose synthesis are shown to be consistent with its formation through the reverse of the normal glycolytic sequence. The dark fixation of $C^{14}O_2$ by green plants is reported to be similar to that of other microorganisms. Fixation is believed to occur by virtue of reversible decarboxylation reactions of the tricarboxylic acid cycle. The respiration of intermediates of sucrose synthesis, immediately previously photosynthesized, is extremely slow at high light intensities but is rapid in the dark. 21 references. (auth)

2676

Brookhaven National Lab.
THE METABOLISM OF $C^{14}O_2$ BY SUNFLOWER LEAVES;

p.139-45 of BROOKHAVEN CONFERENCE REPORT; CO_2 ASSIMILATION REACTIONS IN BIOLOGICAL SYSTEMS; JUNE 7–8, 1950. Martin Gibbs. Dec. 1950. 7p. (BNL-70(p.139-45))

The rate at which assimilated CO_2 is distributed in the carbon of plant sugars and other substances should provide indication of the interrelations between these materials. Experiments are reported which yield data permitting some deductions concerning such interrelations. Exposure of sunflower leaves to $C^{14}O_2$ and separation of compounds and degradation procedures for sugars, alanine, and malic acid are described. It was evident that the carbohydrates were 3,4-labeled, whereas the alanine and malic acid remained carboxyl-labeled. This fixation of $C^{14}O_2$ was due to the reversibility of the respiratory and fermentative decarboxylations. Obviously, before label can occur in positions other than carbon atoms 3 and 4 of sugar and the carboxyl carbon of amino acids and organic acid, light is necessary to initiate the cycle which synthesizes the C_2 acceptor. From these experiments and those of Benson and Calvin (Ann. Rev. Plant Physiol. 1, 25(1950)), it is evident that light can initiate or inhibit reactions occurring in the plant.

2677

Radiation Lab., Univ. of California
BIOSYNTHESIS OF CHOLESTEROL FROM ISOBUTYRATE. David Kritchevsky and Irving Gray. Jan. 12, 1951. 5p. (UCRL-1080)

Conversion of sodium isobutyrate-3-C^{14} to cholesterol in the intact rat has been demonstrated.

2678

PARTITION OF ORALLY ADMINISTERED RADIOACTIVE PHOSPHORUS IN THE BLOOD AND MILK OF THE DAIRY COW. P. Saarinen, C. L. Comar, S. P. Marshall, and George K. Davis. J. Dairy Sci. 33, 878-84(1950) Dec.

When tracer P^{32} was given orally to a cow in mid-lactation, the blood showed a marked activity after 59 min, mainly owing to the activity of blood-plasma acid-soluble P fraction. Later, two activity maximums were noted in both whole blood and blood plasma; the first appeared about 5 to 6 hr after the beginning of the test, and the second appeared about 30 hr later. During the first of these periods, only the acid-soluble P fraction in plasma was labeled. The blood-plasma phospholipid P fraction did not show any activity until several hours later. The increase in the specific activity of phospholipid P fraction also was much slower than in the plasma acid-soluble P fraction. The comparison of the specific activity of P in different blood and milk fractions at different periods following administration of P^{32} shows clearly that both the acid-soluble P in the milk serum and the casein P originate from the blood-plasma acid-soluble P fraction and not from the phospholipid P fraction. On the basis of the proportionally high activity of both the casein P and the acid-soluble P in milk serum, it is considered that possibly only one fraction of the phosphates usually determined as blood-plasma inorganic phosphates serves as the main precursor of the P in milk. There was some evidence to indicate that blood-plasma phospholipids also may be removed from the blood by the mannary gland. (auth)

2679

TISSUE DISTRIBUTION OF S^{35} IN THE RAT FOLLOWING ORAL ADMINISTRATION OF LABELED SULFANILAMIDE. E. G. Fingl, J. E. Christian, and L. D. Edwards. J. Am. Pharm. Assoc. Sci. Ed. 39, 693-5(1950) Dec.

S^{35} was found to be relatively uniformly distributed in the animal body at 1, 2, 4, 8, and 24 hr after administration of labeled sulfanilamide. The same was true 2 hr after the last of 16 to 18 doses at 4-hr intervals. The tissues concerned with excretion and detoxification tended to show, particularly at the later time intervals, concentrations slightly higher than the other tissues. There is no evidence of extensive binding of sulfanilamide by the tissues. 16 references (auth)

CHEMISTRY

2680

Brookhaven National Lab.
FRACTIONATION OF THE CARBON ISOTOPES IN DECARBOXYLATION REACTIONS; IV. THE RELATIVE RATES OF DECOMPOSITION OF 1-C^{12} AND 1-C^{13} TRICHLORACETATE IONS. Jacob Bigeleisen and Thomas L. Allen. [nd.] 22p. (AECU-1160)

A precise determination of the relative rates of decomposition of 1-C^{12} and 1-C^{13} trichloroacetate ions has been made. The 1-C^{12} ion has been found to decompose 1.0338 ± 0.0007 times as fast as the 1-C^{13} ion into chloroform and bicarbonate at 70.4°C. Trichloroacetate ion has been found to undergo a decomposition reaction which gives chloride ion but no CO_2, OH^-, or H^+. The ratio of the rate constants for the production of Cl^- and bicarbonate is 0.078. The errors in the determination of the effect of isotopic substitution on the rates of chemical reactions are discussed. In the study of the isotopes of carbon, experiments using mass spectrometric analyses of C^{13} at the natural abundance level are capable of a precision of one order of magnitude greater than ones in which the specific activity of C^{14} is determined by counting. (auth)

2681

Brookhaven National Lab.
FRACTIONATION OF THE CARBON ISOTOPES IN DECARBOXYLATION REACTIONS; III. THE RELATIVE RATES OF DECOMPOSITION OF CARBOXYL –C^{12} AND –C^{13} MESITOIC ACIDS. Aksel A. Bothner-By and Jacob Bigeleisen. [nd.] 21p. (AECU-1161)

The relative rates of decarboxylation of C^{12}- and C^{13}-carboxyl mesitoic acids have been studied at 61.2 and 92.0°C. The

ratios of the rate constants at these temperatures are 1.037 ± 0.003 and 1.032 ± 0.001, respectively. A comparison is made with similar ratios determined experimentally for other acids and with theoretical calculations of the ratios. (auth)

2682

Brookhaven National Lab.
GUIDE TO RUSSIAN SCIENTIFIC PERIODICAL LITERATURE; VOL. 3, NO. 12. John Turkevich and Ludmila Turkevich. Dec. 1950. 47p. (BNL-89)

Titles in English are given for each paper in the following journals: Doklady Akad. Nauk S.S.S.R. 72, Nos. 5 and 6(1950); Zhur. Tekh. Fiz. 20, Nos. 3,4,5, and 6(1950); Zhur. Obshcheĭ Khim. 19, Nos. 11 and 12(1949); 20, Nos. 1 and 2(1950). A complete index of translations from the Russian which are available at Brookhaven National Laboratory is included.

2683

Carnegie Inst. of Tech.
PROGRESS REPORT FOR DECEMBER 1950. Carl Moore, D. S. McKinney, and J. C. Warner. [nd.] 5p. (NYO-546)

The effect of NaF on the cathodic polarization characteristics is presented for Zr in H_2SO_4. Construction of equipment and changes of procedures are described for the experiments on the solubility of ZnO. (auth)

2684

Radiation Lab., Univ. of California
THE VAPOR PRESSURE OF GERMANIUM BETWEEN 1510°K AND 1882°K. (abstract) Alan Searcy. Jan. 17, 1951. 1p. (UCRL-1087)

The report is reproduced here in its entirety.

The vapor pressure of Ge has been determined between 1510 and 1882°K by the Knudsen effusion method. Thirteen determinations were made in this range using two different hole sizes and Pt collector plates. An additional determination was made with a quartz collector. The results are independent of the size of the hole used in the effusion vessel, and the sticking coefficient (or accommodation coefficient) is unity at the Pt collectors. From the vapor pressures determined in these experiments, an expression can be derived for the free energy of vaporization of liquid Ge: $F^\circ = 86{,}200 + 1.5T \ln T - 41.0T$. This equation indicates that the normal boiling point of Ge is 2970°K. Evidence is presented for the formation of an alloy of Pt with Ge when Ge vapor strikes a Pt collector heated to about 800°K or higher. When the Pt collector is at a lower temperature, or when a quartz collector is used, the Ge deposits without reacting.

2685

ANALOGIES IN THE GALLIA AND ALUMINA SYSTEMS; THE PREPARATION AND PROPERTIES OF SOME LOW-ALKALI GALLATES. L. M. Foster and H. C. Stumpf. J. Am. Chem. Soc. 73, 1590-5(1951) Apr.

No crystal phase of gallia was found which does not have an exact counterpart in the alumina system. Suitable conditions were found for preparing well-crystallized gallia monohydrate and α gallia. The high-temperature form of gallia, which bears the designation β in the literature, has been shown to be isomorphous with θ alumina. Na, K, and Li gallates have been prepared whose structures are completely analogous to the corresponding compounds in the alumina system that are labeled "β" and "ζ" in the literature. Thermal studies have shown that a considerable evolution of heat accompanies the transition from α gallia to the θ-like form, indicating that α gallia is metastable in the temperature range considered. A large heat of crystallization was evolved when amorphous alumina crystallized to γ. A very large exothermal effect was observed when γ alumina transformed to corundum. The last effect is not readily explained. (auth)

2686

THE BEHAVIOR OF SOLUTIONS OF TITANIUM DIOXIDE IN SULFURIC ACID IN THE PRESENCE OF CERTAIN BIVALENT METALLIC SULFATES. S. M. Mehta and R. P. Poncha. J. Am. Chem. Soc. 73, 227-8(1951) Jan.

It is shown that, although it is possible to prepare $CaSO_4 \cdot Ti(SO_4)_2$ as described by Weinland and Kühl (Z. anorg. Chem. 54, 253(1907)), the strontium compound $SrSO_4 \cdot Ti(SO_4)_2$ and the barium compound $2BaSO_4 \cdot 3Ti(SO_4)_2$ described by these authors could not be obtained by following the details given. It has been shown that the solid phase which separated out consists of $TiOSO_4$. Two more compounds of the type $RSO_4 \cdot Ti(SO_4)_2$, where R represents nickel and cadmium, have been prepared and described. (auth)

2687

THE BEHAVIOR OF SOLUTIONS OF TITANIUM DIOXIDE IN SULFURIC ACID IN THE PRESENCE OF METALLIC SULFATES. S. M. Mehta and S. R. Patel. J. Am. Chem. Soc. 73, 224-6(1951) Jan.

A solution of TiO_2 in H_2SO_4 gives a precipitate of $TiOSO_4$ when heated to 285°C. The presence of alkali sulfates retards this precipitation, and sodium sulfate is most effective in this respect. In the presence of bivalent metallic sulfates, the compounds of the type $RSO_4 \cdot Ti(SO_4)_2$ are obtained with different colors depending on the nature of the bivalent metal present in the compound. A similar compound is not obtained when ferrous ammonium sulfate (or ferrous sulfate) is used. The thermal decomposition of $RSO_4 \cdot Ti(SO_4)_2$ has been studied and found to be almost complete at 850°C. The colored residues left at this temperature are intimate mixtures of titania and bivalent metallic oxides with or without a small amount of undecomposed substance and may be useful as paint materials. (auth)

2688

COAGULATION EFFECTS OF THORIUM NITRATE ON AQUEOUS SOLS OF SILVER HALIDES IN STATU NASCENDI; I. THE COAGULATION CURVE AND THE COAGULATION VALUE OF THORIUM NITRATE. B. Težak, E. Matijević, and K. Schulz. J. Am. Chem. Soc. 73, 1603-5(1951) Apr.

The effect of $Th(NO_3)_4$ in various concentrations on systems of $AgNO_3$–HBr and $AgNO_3$–KBr in aqueous solution has been investigated by means of tyndallmetric measurements. By systematic dilution of $Th(NO_3)_4$, the coagulation curve shows four distinct regions, two stabilization and two coagulation.

For the diluted, negatively charged AgBr sols in statu nascendi (5×10^{-4}N $AgNO_3$–2×10^{-3}N HBr) the first limit of coagulation-stabilization (0.02N) represents the critical concentration of coagulation where the coagulating ion is nitrate ion, whereas the stabilizing action is caused by the Th complexes of positive sign in adsorbed state. Under otherwise the same conditions but 2×10^{-4}N $AgNO_3$–4×10^{-4}N HBr and 4×10^{-3}N $Th(NO_3)_4$, the coagulation concentration is shifted from 2×10^{-2}N with KNO_3 to 6×10^{-4}N with K_2SO_4. The second limit of stabilization-coagulation ($\sim 1 \times 10^{-3}$N $Th(NO_3)_4$) is very much influenced by the initial concentration of the $Th(NO_3)_4$ solution and the acidity of the medium. The third limit of coagulation-stabilization ($\sim 3 \times 10^{-5}$N and $\sim 3 \times 10^{-6}$N $Th(NO_3)_4$) gives the coagulation values of Th complexes (probably trivalent and tetravalent, respectively) on the negatively charged AgBr sol.

2689

ELECTROCHEMICAL POTENTIAL IN HYDROFLUORIC ACID SOLUTION AND ELECTROLYTIC POLISHING OF NIOBIUM. M. Cottin and M. Haissinsky. J. chim. phys. 47, 731-2(1950) Sept.-Oct. (In French)

The potential of the Ta/TaF_7^{--} electrode in HF solution was determined previously (Haissinsky et al., J. chim. phys. 44, 234(1947)) to be $E_0 = -0.43$ volt. (The value of −0.46 given in this reference is a computational error.) As part of a continuing study of the electrochemistry of Pa and related elements, the potential of Nb in HF-HNO_3 solution has been measured with some difficulty. Nb shows an even greater tendency to passivation than does Ta; even at pH 0.3 to 0.5 the potential fluctuates from −0.52 to −0.57 volt or sometimes to a more negative value with respect to a saturated calomel electrode. From the value −0.57 volt at pH 0.3 and the assumptions that the activity of the complex is equal to its concentration and that the activity of the H^+ ions is equal to that of the F^- ions, the standard potential for the reaction $Nb + 7F^- = NbF_7^{--} + 5e$ is calculated to be $E_0 \approx -0.33$ volt. From this value and that for Ta, the standard potential for Pa is estimated to be about −0.6 volt. Conditions for electrolytic polishing of Nb are given, and the nature of the surface obtained is described.

2690

THE HEATS OF FORMATION OF TiO, Ti_2O_3, Ti_3O_5, AND TiO_2 FROM COMBUSTION CALORIMETRY. George L. Humphrey. J. Am. Chem. Soc. 73, 1587-90(1951) Apr.

A precise combustion calorimeter has been constructed to measure the heats of combustion of inorganic substances. Calculations from measured heats of combustion for Ti, TiO, Ti_2O_3, and Ti_3O_5 have yielded the following values for the standard heats of formation ($-\Delta H_f^\circ$) in kilocalories per mole: TiO, $123.9_1 \pm 0.2_8$; Ti_2O_3, $362.9_3 \pm 0.4_8$; Ti_3O_5, $586.9_1 \pm 0.6_9$ [$586.6_9 \pm 0.6_9$ in text]; TiO_2, $225.5_2 \pm 0.2_3$. Free energies of formation also are presented. (auth)

2691

LOW TEMPERATURE HEAT CAPACITIES OF INORGANIC SOLIDS; V. THE HEAT CAPACITY OF PURE ELEMENTARY BORON IN BOTH AMORPHOUS AND CRYSTALLINE CONDITIONS BETWEEN 13 AND 305°K. SOME FREE ENERGIES OF FORMATION. Herrick L. Johnston, Herbert N. Hersh, and Eugene C. Kerr. J. Am. Chem. Soc. 73, 1112-17(1961) Mar.

Pure B has been prepared in both the amorphous and crystalline forms in sufficient quantity to permit accurate heat-capacity determinations. Heat capacities were measured from about 16 to over 300°K. The data yield a value of 1.403 ± 0.005 cal/mole/deg for the entropy of crystalline B at 298.16°K and yield 1.564 ± 0.01 cal/mole/deg for that of amorphous B relative to S_0°. Tables of thermodynamic functions have been prepared for smoothed values of the temperature. Crystalline B satisfies the T^3 law for temperatures between 60 and 125°K to within about 3% and satisfies the Debye equation to within about 2% when θ_D is set equal to 1219. As in the case of diamond, observed heat capacities above 125°K are higher than those given by the T^3 law or by the Debye equation. Amorphous B fails to fit either the T^3 law or the Debye equation, but its capacity between 50 and 75°K corresponds roughly to a θ_D of 1102. Low maxima are observed below 30°K for both the amorphous and crystalline forms. The maximum for the amorphous form is somewhat higher than that of the crystalline form and occurs at a lower temperature. There may be some correlation between these maxima and the narrow 2p doublet that constitutes the ground state of the B atom. Standard free energies have been evaluated for the formation of B_2O_3 (crystalline), the formation of H_3BO_3 (crystalline), and the hydration of H_2O_3 to form the acid. (auth)

2692

NEW ATOMS. Otto Hahn. New York, Elsevier Publishing Co., Inc., 1950. 184p.

The first chapter is Prof. Hahn's Nobel Lecture delivered when he was awarded the Nobel Prize for Chemistry in 1944. In it he summarizes rapidly the steps that led from the first studies of neutron bombardment of the very heavy nuclei to the realization that fission of the nuclei was taking place in these experiments. Chapter II, retracing in more detail some of the material in the first chapter, discusses the character of these fission reactions, the chain reactions, the roles of U^{235} and U^{238} in the pile, production of Pu, and industrial and explosive uses of the new energy sources. In the third chapter, the artificial new elements 43, 61, 85, 87, and 93 to 98, inclusive, are discussed in detail. The place of the transuranium elements in the periodic table is briefly discussed. The fourth and last chapter is devoted to Prof. Hahn's personal reminiscences of the early days of radiochemistry. The preceding synopsis is taken from a review by A. D. Franklin, J. Franklin Inst. 251, 300-1(1951) Feb.

2693

NOTIONS MODERNES SUR L'ATOME ET LA VALENCE. A. Travers. Paris, Librairie Vuibert, 1950. 208p. (In French)

An exposition, intended principally for chemists, of fundamentals of electronic theories of the periodic table and of chemical valences and bonds is given; the last chapter gives general information on the nucleus, nuclear reactions, the fission reactor, and the applications of isotopes.

2694

PHASE DIAGRAMS OF THE $ZrCl_4$–NaCl AND ZrO_2–$CaCl_2$ SYSTEMS AND DIRECTIONS FOR PREPARING PURE SALTS $ZrCl_4$ AND $TaCl_5$; trans. from Zhur. Priklad. Khim. 13, No. 11, 1545-55(1940). N. A. Belozerskiy and O. A. Kucherenko. 1940. 6p. (NP-2251; OO-W-16119)

For the preparation of $ZrCl_4$, finely powdered zircon was mixed with ground charcoal in the proportion 10:4 by weight. The charge was fed into an Acheson furnace and calcined for 6 to 8 hr at a temperature of 2000°C. The product is a fused or crystalline mixture of Zr carbides containing a small quantity of iron and probably some carborundum. This product was chlorinated either as it came from the furnace or upon grinding and briquetting with charcoal in the proportion of 10:3. Chlorination was carried out at 600 to 650°C in a nichrome tubular furnace. The preparation of pure $TaCl_5$ also is described. The crude material is the so-called "technical oxide" of Nb, which contains approximately 50% of the combined oxides of Nb and Ta, about the same quantity of TiO_2, and 1 to 2% of Fe oxide. The technical oxide (1 kg) was briquetted with charcoal (300 g), using molasses as a binder. The briquettes were dried at 70 to 90°C and coked at 750 to 800°C. The coked briquettes were chlorinated at 650 to 700°C. By reason of the high volatility of $ZrCl_4$ and the tendency toward hydrolysis exhibited by both $ZrCl_4$ and $CaCl_2$, the data for the phase diagrams had to be determined in hermetically sealed vessels and in the medium of a suitable gas, namely chlorine. The experimental investigation was limited to samples containing less than 90% of $ZrCl_4$ by weight. The phase diagram of the ZrU_4–NaCl system shows two definite compounds corresponding to $4NaCl \cdot ZrCl_4$ and $NaCl \cdot ZrCl_4$. There is also the possibility that the unstable compound $2NaCl \cdot ZrCl_4$ exists. The melting points of the three eutectics are 390, 220, and 162°C. The melting points of the two well-defined compounds are 535 and 330°C. The phase diagram of the ZrO_2–$CaCl_2$ system discloses a total lack of solubility in the range 767 to 772°C.

2695

Columbia Univ.
RADIOCHEMICAL LABORATORIES; sect. IV of PROGRESS REPORT; NUCLEAR PHYSICS LABORATORIES. J. R. Dunning, Director. Sept. 30, 1950. 2p. (CUD-61(sect. IV))

A Na-free sample of potassium metaborate was prepared for use as an internal cyclotron target in the preparation of K^{42}. Further experiments on the Szilard-Chalmers reaction on triphenylarsine have shown conclusively that "hot" As atoms do not react with the solvent. A procedure for the quantitative electrodeposition of pure Tc has been worked out. The preparation of B standards for neutron spectrometer studies has been initiated. The standards consist of B-glass plates containing an accurately known amount of B. (auth)

2696

RECOVERY OF TITANIA FROM THE BAUXITE SLUDGE. S. M. Mehta and S. R. Patel. J. Am. Chem. Soc. 73, 226-7 (1951) Jan.

The recovery of titania from its H_2SO_4 solution in the form of $RSO_4 \cdot Ti(SO_4)_2$ has been found to be about 100%. When solutions of titania in H_2SO_4 are heated in the presence of $Al_2(SO_4)_3$, substances which appear to be either titanyl sulfate with small amount of Al or $Al_2(SO_4)_3$ with small amount of Ti are obtained. By experimenting with artificial mixtures containing TiO_2, $Al_2(SO_4)_3 \cdot 18H_2O$, and $Fe_2(SO_4)_3 \cdot 9H_2O$ approaching the proportion present in the bauxite sludge, it is shown that titania can be recovered quantitatively from its H_2SO_4 solution in the form $ZnSO_4 \cdot Ti(SO_4)_2$. It is shown that, from a sample of bauxite sludge, titania can be recovered by taking advantage of the formation of $RSO_4 \cdot Ti(SO_4)_2$ which either can be hydrolyzed and then ignited to give pure titania or can be decomposed thermally into colored residues which may be useful as paint materials.

2697

A REINVESTIGATION OF THE STRUCTURES OF DIBORANE AND ETHANE BY ELECTRON DIFFRACTION. Kenneth Hedberg and Verner Schomaker. J. Am. Chem. Soc. 73, 1482-7(1951) Apr.

The ethane-like model for diborane has been eliminated, and the bridge model has been confirmed in an electron-diffraction reinvestigation of diborane and ethane which has led to the bond-angle and bond-distance values $\angle H_{bond}\ B - H_{bond} = 121.5 \pm 7.5°$, $B-B = 1.770 \pm 0.013$ A, $B-H_{bond} = 1.187 \pm 0.030$ A, and $B-H_{bridge} = 1.334 \pm 0.027$ A for diborane, and $\angle C-C-H = 110.5 \pm 3.5°$, $C-H = 1.114 \pm 0.027$ A, and $C-C = 1.536 \pm 0.016$ A for ethane. A reasonable combination of the values for ethane with the spectroscopic moments of inertia gives $\angle C-C-H = 110.4°$, $C-H = 1.110$ A, and $C-C = 1.535$ A, in excellent agreement with the purely electron-diffraction results and considerably more precise. (auth)

2698

SPECTROPHOTOMETRIC STUDIES OF COBALT(II) THIOCYANATE COMPLEXES IN ORGANIC SOLVENTS. Leonard I. Katzin and Elizabeth Gebert. J. Am. Chem. Soc. 72, 5659-62(1950) Dec.

In very dilute solution in acetone, cobalt(II) thiocyanate yields trithiocyanate and tetrathiocyanate complexes. In dilute solution in isopropyl or t-butyl alcohol, only dithiocyanate and trithiocyanate complexes are found. The extinction coefficient of the tetrathiocyanate complex is about twice that of the trithiocyanate complex. In relatively concentrated solution in acetone, an unstable complex involving a single thiocyanate group can be identified.

2699

THE TITANIUM–HYDROGEN SYSTEM AND TITANIUM HYDRIDE; II. STUDIES AT HIGH PRESSURE. Thomas R. P. Gibb, Jr., James J. McSharry, and Robert W. Bragdon. J. Am. Chem. Soc. 73, 1751-6(1951) Apr. (See also NSA 5-1504)

The equilibrium pressure of hydrogen over the metallic titanium–hydrogen system has been measured as a function of the hydrogen content of the solid phase. Measurements were made over the range 175 to 1000°C at pressures ranging up to 5000 cm, and the results were plotted as log P versus reciprocal of absolute temperature. A series of straight lines was obtained whose slope increases with decreasing hydrogen content. From these slopes the differential heats of dissociation were calculated. A family of isotherms shows plateaus at compositions approaching TiH_2 indicating presence of a novel phase. (auth)

ANALYTICAL PROCEDURES

2700

Mineral Engineering Lab., Mass. Inst. of Tech.
THE USE OF HIGH-EFFICIENCY GAMMA COUNTING IN

CONJUNCTION WITH BETA COUNTING FOR DISCRIMINATION BETWEEN THORIUM AND URANIUM. Robert H. Roethlisberger. Aug. 20, 1949. Decl. Feb. 13, 1951. 14p. (AECD-3062; MITG-219)

Use of the high-pressure γ chamber and vibrating-reed electrometer to measure γ activity and the end-window Geiger counter to measure β activity has permitted discrimination between activity due to Th and that due to U so that the Th and U content of ore samples can be determined radiometrically within a factor of 2 and usually within 15%. (auth)

2701

Iowa State Coll.
AN EMPIRICAL TITRIMETRIC METHOD FOR THE DETERMINATION OF BERYLLIUM. John H. McClure and Charles V. Banks. Apr. 21, 1950. 12p. (ISC-109)

The Craig method (J. Soc. Chem. Ind. (London) 30, 184 (1911)) for titrating Al has been modified and applied to the determination of Be. This method consists in adjusting the pH of a solution of Be to 8.5, followed by the addition of NaF or KF and titration of the liberated NaOH with a standard acid solution. A precision of greater than two parts per thousand is obtained. A glass electrode is used for the pH adjustments. (auth)

2702

Columbia Univ.
ANALYTICAL LABORATORY AND CRYSTAL GROWING, sect. III of PROGRESS REPORT; NUCLEAR PHYSICS LABORATORIES. J. R. Dunning, Director. Sept. 30, 1950. 2p. (CUD-61(sect.III))

A pure sample of NaF has been prepared for use in paramagnetic scattering experiments. A method has been worked out for the preparation of FeF_3 by the reaction of HF on anhydrous $FeCl_3$. Further exploratory experiments have been carried out on the preparation of $Na_3Fe(CN)_6$. A detailed neutron spectroscopic analysis has been made for five samples of Sn containing 0.5, 0.1, 0.05, 0.01, and 0.003%, respectively, of In. Exploratory work has been performed on the problem of utilizing neutron-transmission data to study hydrogen content and binding. A new method of analyzing deuterium is being developed which utilizes equilibration of acetylene with water containing deuterium, followed by analysis of the acetylene with the mass spectrometer. (auth)

2703

CONDUCTOMETRIC TITRATION OF SEVERAL METALLIC CITRATES AND TARTRATES IN THE PRESENCE AND ABSENCE OF HYDROGEN PEROXIDE. M. M. Bobtelsky and A. E. Simchen. Bull. soc. chim. France, 870-3(1950) Sept.-Oct. (In French)

The following substances in aqueous and 0.1N H_2O_2 solutions have been titrated conductometrically with trisodium citrate: $AgNO_3$, $BaCl_2$, $CdCl_2$, $CoCl_2$, $CuSO_4$, $Fe(NH_4)_2(SO_4)_2$, $MgSO_4$, $MnCl_2$, $NiSO_4$, $Pb(NO_3)_2$, $UO_2(NO_3)_2$, $ZnSO_4$, $AlCl_3$, $Ce_2(SO_4)_3$, $Cr_2(SO_4)_3$, $FeCl_3$, Na_2WO_4, $NaVO_3$, and $(NH_4)_2MoO_4$. The same operations have been carried out with disodium tartrate on the following: $CoCl_2$, $CuCl_2$, $CuSO_4$, $UO_2(NO_3)_2$, $AlCl_3$, $Cr_2(SO_4)_3$, $KCr(SO_4)_2$, and $FeCl_3$. With the single exception of that of lead, all the titration curves of the divalent cations and Ag^+ showed inflection points at one Me^{++} per one anion. Results for the trivalent cations varied from metal to metal. Although of roughly the same composition, the structures of the divalent complexes may vary as much as those of the trivalent. The role of the hydroxyl and carboxyl groups is discussed.

2704

INVESTIGATIONS ON COULOMETRIC ANALYTICAL METHODS: I. VANADIUM COULOMETER, A NEW TYPE OF TITRATION COULOMETER. V. S. Syrokomskiĭ and T. I. Nazarova. Zhur. Anal. Khim. 6, No. 1, 15-23(1951). (In Russian)

Coulometric methods permit a quantitative determination of substances that have taken part in an electrochemical reaction, by measuring the quantity of electricity that has passed through a coulometer connected in series with the reaction cell. First suggested by Zakhar'evskiĭ (Voprosy Pitaniya 7, 180(1938)), these methods have been developed by several workers (see Lingane, Anal. Chem. 21, 497 (1949)). An accurate and short procedure is described involving a V coulometer, which consists of Pt electrodes and a solution (of various concentration) of V(IV) sulfate in H_2SO_4; the quantity of electricity consumed is measured by titrating with a solution of $(NH_4)_2Fe(SO_4)_2$ in H_2SO_4. Similar experiments with a Ce(III) coulometer gave no satisfactory results, owing, perhaps, to insufficient purity of Ce salts available.

2705

MILLICOULOMETRY; I. CONSTRUCTION AND OPERATION OF AN APPARATUS FOR THE DETERMINATION OF POLAROGRAPHIC n-VALUES. Stephen Bogan, Louis Meites, Earl Peters, and Julian M. Sturtevant. J. Am. Chem. Soc. 73, 1584-7(1951) Apr.

The design and calibration of a millicoulometer incorporating an integrating relay and accessory electronic circuits are described. When this instrument is used to integrate the current flowing through a polarographic circuit under such conditions that a considerable decrease in the concentration of reducible or oxidizable material takes place during the electrolysis, data are obtained from which the value of n, the number of faradays per mole of electrode reaction, can be computed. The application of the method is illustrated by data on some representative inorganic reductions. (auth)

2706

POLAROGRAPHIC BEHAVIOR OF ORGANIC COMPOUNDS; IX. IODOACETIC ACID AND THE BROMOACETIC ACIDS. Philip J. Elving, Isadore Rosenthal, and Marilyn Koll Kramer. J. Am. Chem. Soc. 73, 1717-22(1951) Apr.

In the pH range 1 to 12, iodoacetic acid gives one polarographic wave, whereas tribromoacetic acid gives three waves, the most negative of which is identical in characteristics with the one wave of monobromoacetic acid and the more negative of the two waves of dibromoacetic acid. The intermediate tribromoacetate wave is identical in behavior with the more positive dibromoacetate wave. Each wave is

irreversible with the possible exception of the most positive tribromoacetate wave. Each wave represents a two-electron current-producing process, which is due to the fission of a carbon-halogen bond. The mechanism of reduction is the step-by-step removal of halogen, e.g., tribromoacetic going to dibromoacetic and then to bromoacetic. There is an S-shaped relation between $E_{0.5}$ and pH; the pH value equal to the pK_a of the acid is located on the rising portion of the curve. The $E_{0.5}$ becomes more negative with increasing pH and may be pH independent in portions of the acidic and basic regions. (auth)

2707

QUANTITATIVE ANALYSIS OF MIXTURES OF RADIOACTIVE INORGANIC SALTS BY ACTIVITY MEASUREMENT. O. Gübeli and W. Kolb. Helv. Chim. Acta. 33, 1534-40(1950) Oct. 16. (In German)

The β and γ radiations of mixtures of solid radioactive substances with inactive salts have been measured. The activities of thorium oxalate, thorium oxide, and thorium nitrate in mixtures of constant total weight with inactive salts showed linear slope when plotted against Th content. This straight line for the mixture may be correlated with the "saturation curve" of the pure substance over the range 0 to 250 mg of Th. A regularity is shown between different mixtures of anions at constant total weight.

2708

RAPID DETERMINATION OF THORIUM IN MONAZITE SAND. N. K. Dutt. Science and Culture 15, 448-9(1950).

Thorium was determined thermometrically by titration with a solution of sodium pyrophosphate in acid solution obtained directly by the decomposition of monazite sand after adjusting the acid concentration to ~1.2N.

2709

A STUDY OF TITANIUM PHOSPHATES. V. I. Spitsyn and E. A. Ippolitova. Zhur. Anal. Khim. 6, No. 1, 5-14(1951). (In Russian)

Although the quantitative determination of Ti as a phosphate is universally accepted in analytical chemistry, definite knowledge of the composition and properties of that precipitate is lacking. It is shown that, dried at room temperature, the precipitate has the approximate composition of a titanyl hydrophosphate $(TiO)HPO_4 \cdot 2.5H_2O$; however, through hydrolysis the Ti content is usually somewhat higher. Hydrolysis is also responsible both for the loss of a considerable fraction of phosphate ions during the washing of the precipitate and for a still greater loss of these ions in alkaline media. Other sources of complications are the coagulation of colloidal titanic acid by phosphate ions and the chemisorption of the latter by the titanic acid gel. Optimal conditions for the formation of a precipitate for analytical purposes are indicated.

CRYSTALLOGRAPHY AND CRYSTAL STRUCTURE

2710

Argonne National Lab.
A STUDY OF EQUILIBRIUM PHASES IN THE SYSTEM UO_2-ZrO_2. (File 1305) Wingate A. Lambertson and Melvin H. Mueller. Jan. 1951. Decl. Feb. 27, 1951. 15p. (AECD-3068)

Phase-equilibrium studies made on the system UO_2-ZrO_2 reveal that the system consists primarily of two solid solutions separated by a two-phase region which decreases in area as the temperature is increased. The UO_2 solid solution is cubic. It extends from 0 to 40% ZrO_2 by weight, and its lattice parameter varies from 5.460 to 5.277 kX with increasing per cent of ZrO_2. The ZrO_2 solution is tetragonal and extends from 50 to 100% ZrO_2. Its lattice parameters vary as follows: a_0 from 5.23 to 5.07 kX and c_0 from 5.27 to 5.16 kX. There is also evidence of a solid solution in monoclinic ZrO_2. (auth)

2711

Oak Ridge National Lab.
X-RAY DIFFRACTION AND CRYSTAL STRUCTURE; p.78-84 of QUARTERLY PROGRESS REPORT FOR PERIOD ENDING SEPTEMBER 20, 1950; PHYSICS DIVISION. M. A. Bredig, R. M. Steele, B. S. Borie, Jr., and F. A. Sherrill. Jan. 8, 1951. 7p. (ORNL-865(p.78-84))

Cobalt ammonium sulfate hexahydrate and its many isomorphs have interesting magnetic properties, which depend on the crystal structure. These properties have been under investigation for some time by the low-temperature physics group, and it was thought that the structures should be reexamined. A rotation photograph and a zero-layer Weissenberg photograph for rotation about the c axis were made using copper radiation filtered through nickel foil. Intensities were estimated visually from the Weissenberg photograph and reduced to structure factors. Some differences between the values observed and those predicted by Hofmann's structure (Z. Krist. 78, 279(1931)) were found. Line-broadening was measured on the etched and unetched surface of a Cu-Be alloy specimen with a Norelco high-angle x-ray-diffraction spectrometer, using filtered copper Kα radiation and the 331 reflection of the cubic face-centered lattice at $2\theta = 140$ deg, where the Kα doublet was fully resolved. The increase in the half-width of the reflections amounted to approximately 35%. An apparent large and as yet unexplained simultaneous drop in the integrated intensity of the reflections on irradiation is reported. Two experiments have been carried out, one at 500 and the other at 900°C, in which BeO was heated in a small mullite mortar mounted inside a vertical tube furnace. The beryllium oxide was ground for several minutes, a time long enough to produce noticeable amounts of transformation in other substances such as PbO, ZnS, or CaC_2. X-ray-diffraction examination of the powder did not reveal any trace of a cubic phase. The carbides (MeC_2) of calcium, strontium, and barium exhibit enantiotropic transitions, from tetragonal symmetry at low temperatures to cubic symmetry at high temperatures at 450, 370, and below 200°C, respectively. The lattice dimensions increase regularly with the atomic number as the transition temperatures decrease, as shown in tabular form. It appears that the forces active between uranium and C_2^{--} ions are indeed different from, i.e., stronger than, those between the noble-gas-type Ca^{++} cation and the C_2^{--} ions, leading to a higher temperature of conversion (if any occurs). Single crystals of Cu were found to be of great value in neutron diffraction. Intensities were found increased by a factor of 5, probably because of a fa-

vorable mosaic structure of the crystal used. For use with a neutron energy of maximum intensity in the epithermal range, reflection at the 111 plane is favored, and a Pfankuchen angle of 7 deg for "focusing" is recommended. It appears that crystals having the desired orientation within 5 deg are more readily obtained by keeping the crucible stationary and lowering the temperature of the furnace than vice versa.

2712

ON THE STRUCTURE OF ELEMENTARY BORON. J. L. Hoard. J. Am. Chem. Soc. 73, 1892-3(1951) Apr. (Communication to the editor) (See also NSA 5-2422)

An approximate structure has been determined for one modification of elementary boron from a study of needle-like single crystals. Complete (Cu Kα) Weissenberg x-ray data together with the density, 2.31 g/cc, establish a tetragonal unit with a = 8.73 ± 0.02, c = 5.03 ± 0.02 A, containing 50 atoms. The observed symmetry and glide-plane vanishings are characteristic of D_{4h}^{14} – P4/mnm, C_{4v}^{4} – P4nm, and D_{2d}^{8} – $P\bar{4}n2$, but the absence of peaks in the Patterson section P(00Z) virtually eliminates D_{4h}^{14}. Parameters and discussion of the structure are given. Further measurements are planned to reduce the space-group ambiguity and to improve the quality and range of the data.

2713

VANADIUM PENTOXIDE: A COMPOUND WITH FIVE-COORDINATED VANADIUM ATOMS. Anders Byström, Karl-Axel Wilhelmi, and Otto Brotzen. Acta Chem. Scand. 4, 1119-30(1950).

The crystal structure of V_2O_5 has been investigated. No evidence was found for hemihedral symmetry either in intensities of reflections or in etch figures. The space group is D_{2h}^{13}-Pmmn, and the atoms occupy the following positions:

4 V in 4 (f): $x_1, y_1, 0; \bar{x}_1, y_1, 0; \frac{1}{2} + x_1, y_1, \frac{1}{2}; \frac{1}{2} - x_1, \bar{y}_1, \frac{1}{2}$

4 O_1 in 4 (f): $x_2, y_2, 0$

4 O_2 in 4 (f): $x_3, y_3, 0$

2 O_3 in 2 (a): $0, y_4, 0; \frac{1}{2}, \bar{y}_4, \frac{1}{2}$

$x_1 = 0.1486 \pm 0.0015$ $\quad y_1 = 0.105 \pm 0.003$

$x_2 = 0.149 \pm 0.004$ $\quad y_2 = 0.458 \pm 0.014$

$x_3 = 0.320 \pm 0.004$ $\quad y_3 = 0.000 \pm 0.014$

$y_4 = 0.000 \pm 0.006$

The vanadium atoms are surrounded by five oxygen atoms which form trigonal bipyramids around the V atoms with V–O distances ranging from 1.54 to 2.02 A. The weak cohesion of the crystals in the b directions is probably due to a sixth much weaker V–O bond with a distance V–O of 2.81 A. The shortest O–O distance is 2.39 A.

FLUORINE AND FLUORINE COMPOUNDS

2714

THE ACTION OF ALKANOLS ON TETRAFLUOROETHYLENE. J. D. Park, M. L. Sharrah, W. H. Breen, and J. R. Lacher. J. Am. Chem. Soc. 73, 1329-30(1951) Mar.

Saturated fluorinated alkyl ethers, $ROCF_2CF_2H$, have been prepared by adding alkanols to $CF_2=CF_2$ under autogenous pressure in the presence of a base. These ethers are quite stable. Attempts to prepare them by bubbling the olefin through a sodium alkoxide solution at atmospheric pressure failed. Their structure was proved by hydrolysis to CHF_2-COOR with H_2SO_4 and silica gel. Physical properties, including infrared and ultraviolet absorption spectra, are given. (auth)

2715

THE ACTION OF ELEMENTARY FLUORINE UPON ORGANIC COMPOUNDS; XVI. THE VAPOR PHASE FLUORINATION OF CHCl = CCl – CHF_2. Murray Hauptschein and Lucius A. Bigelow. J. Am. Chem. Soc. 73, 1428-30(1951) Apr.

The vapor-phase fluorination of the relatively highly deactivated halo-olefin CHCl=CCl–CHF_2 under mild operating conditions has been studied. The reaction pattern involving certain preferred sequences has been shown to be quite similar to that observed in an earlier study of the fluorination of trichloroethylene; and it has to this extent been generalized. The structure of the olefin has now been proved unequivocally by a novel method involving direct fluorination followed by dechlorination. A number of new fluorochloro- and fluorobromopropanes and a tetrafluoropropene have been prepared and characterized. (auth)

2716

ALKYL-SUBSTITUTED CHLOROFLUOROETHANES. John T. Barr, J. Donald Gibson, and R. H. Lafferty, Jr. J. Am. Chem. Soc. 73, 1352(1951) Mar. (Note)

The Prins reaction has recently been extended to include the addition of polyhalo alkanes to polyfluoro alkenes. The present note describes the $AlCl_3$-catalyzed condensation of monochloroalkanes with chlorotrifluoroethylene and unsym-dichlorodifluoroethylene. The expected products were obtained with poor conversions, and in addition materials were obtained in which the $AlCl_3$ had substituted Cl for F in the original addition products.

2717

COMPLETELY HALOGENATED ETHANES CONTAINING IODINE. John T. Barr, J. Donald Gibson, and Robert H. Lafferty, Jr. J. Am. Chem. Soc. 73, 1352-3(1951) Mar. (Note)

The use of highly fluorinated materials in Grignard syntheses has been relatively unsuccessful, except to give the corresponding fluorohydrocarbon. During the course of the work two completely halogenated ethanes containing iodine, 1,2-dichloro-1,1,2-trifluoro-2-iodoethane, and a material thought to be 1-chloro-1,2,2-trifluoro-1,2-diiodoethane were prepared. Ethereal solutions of both compounds reacted readily with Na or Mg, but all attempts to perform a Grignard synthesis were unsuccessful. The Grignard reagent itself apparently was formed by the usual procedure, forming a lower layer in the reaction flask, although there was no evidence of reaction upon the addition of compounds such as benzaldehyde, methyl ethyl ketone, or α-naphthyl isocyanate. These compounds always were recovered unchanged. No olefins or condensation products of the haloethanes could be found either in the reaction mixture or as gaseous products of the reaction.

2718

DILATION OF ORGANIC FLUORIDE COMPOUNDS. Jean-Francois Joliet. Compt. rend. 232, 56-8(1951) Jan. 3. (In French)

The F atom in compounds of the type $C_nH_{2n+1}F$ occupies a volume close to that occupied by the free atom. Its atomic coefficient of expansion is therefore that of a free gas. Since a similar situation exists for the terminal H atoms, an additive formula for the coefficient of expansion of monofluorohydrocarbon molecules is derived and illustrated with C_4H_9F, $C_6H_{13}F$, and $C_7H_{15}F$. The same formula with different coefficients applies to monobromohydrocarbons but not to similar iodine compounds.

2719

THE DIPOLE MOMENTS OF SOME FLUORINE-CONTAINING ORGANIC COMPOUNDS; I. Paul E. Brown and Thomas De Vries. J. Am. Chem. Soc. 73, 1811-12(1951) Apr.

A heterodyne-beat-frequency method was employed for the determination of dipole moments of 15 fluorine-containing organic compounds by the dilute-solution technique. Hedestrand's equation (Z. physik. Chem. B2, 428(1929)) was used to calculate the polarization of the solute at infinite dilution. (auth)

2720

THE DIPOLE MOMENTS OF SOME FLUORINE-CONTAINING ORGANIC COMPOUNDS; II. Albert L. Myers and Thomas De Vries. J. Am. Chem. Soc. 73, 1813-15(1951) Apr.

A heterodyne-beat-frequency method was employed for the determination of dipole moments of 32 fluorine-containing organic compounds by the dilute-solution technique. Both Hedestrand's (Z. physik. Chem. B2, 428(1929)) and Guggenheim's (Trans. Faraday Soc. 45, 714(1949)) method of calculating dipole moments were used, giving results that agree well with each other.

2721

MOLECULAR WEIGHT OF POLYTRIFLUOROCHLOROETHYLENE BY HIGH TEMPERATURE OSMOMETRY. H. S. Kaufman and M. S. Muthana. J. Polymer Sci. 6, 251(1951) Feb. (Letter to the editor)

A high-temperature osmotic-pressure technique has been employed to determine the molecular weight of samples of trifluorochloroethylene polymer (KEL-F). This polymer is characterized by its insolubility at ordinary temperatures, but solutions of low concentration can be prepared in certain chlorofluorocarbon solvents at elevated temperatures.

2722

PENTAFLUOROBENZOIC ACID. E. T. McBee and Edward Rapkin. J. Am. Chem. Soc. 73, 1366(1951) Mar. (Note)

Synthesis of pentafluorobenzoic acid in low yield by H_2SO_4 hydrolysis of perfluorotoluene is described. Reduction of pentafluorobenzoic acid with $LiAlH_4$ gave pentafluorobenzyl alcohol in good yield. The alcohol was not isolated but was converted to the corresponding p-nitrobenzoate and isolated as such. (auth)

2723

POSITIVE BROMINE FROM PERFLUORINATED N-BROMOIMIDES. Albert L. Henne and William F. Zimmer. J. Am. Chem. Soc. 73, 1103-4(1951) Mar.

The syntheses of perfluorinated N-bromosuccinimide, $COCF_2CF_2CONBr$, and perfluorinated N-bromoglutarimide. $COCF_2CF_2CF_2CONBr$, are described. The $-CF_2CO-$ groups attached to the N make the H very protonic in the imides and the Br very positive in the N-bromoimides. Reaction with toluene at room temperature causes ring bromination only, whereas at 90°C side-chain and ring bromination occurs to comparable extent. No reaction occurs with aqueous $AgNO_3$. Perfluorinated N-bromoimides can be used as a source of either atomic or positive Br by control of the experimental conditions. (auth)

2724

RAMAN EFFECT AND ULTRAVIOLET ABSORPTION SPECTRA OF MOLYBDENUM AND TUNGSTEN HEXAFLUORIDES. K. N. Tanner and A. B. F. Duncan. J. Am. Chem. Soc. 73, 1164-7(1951) Mar.

The Raman effect for MoF_6 and WF_6 has been studied, and three lines were found for each molecule. Two of the lines are weak and diffuse, and the third is strong, sharp, and highly polarized. The result indicates octahedral structure for these molecules. If this symmetry is assumed, the Raman inactive frequencies can be calculated from force constants obtained from the Raman active frequencies. Exploratory studies have been made on the ultraviolet absorption spectra of these molecules. A strong absorption band has been found for each, with a center probably around 1850 A for MoF_6 and about 1750 A for WF_6. This appears to represent the first allowed electronic transition. An interesting banded structure was found for this transition in MoF_6. (auth)

2725

REACTION OF PERFLUOROALKYL CHLORIDES WITH SILICON. E. F. Izard and Stephanie L. Kwolek. J. Am. Chem. Soc. 73, 1156-60(1951) Mar.

An attempt has been made to prepare perfluoroalkyl Si halides by the direct thermal addition of perfluoroalkyl chlorides to Si and Si−Cu alloy at various temperatures. Below 400°C, in which temperature range alkyl halides react, no reaction takes place with the perfluoro compounds. At higher temperatures (500 to 1000°) an exothermic reaction takes place which is not addition to Si to form perfluoro Si chlorides, but appears to be a complete transfer of halogen from C to Si. The volatile reaction products appear to be Si halides, and C has been identified in the Si bed. The smoothness of the reaction suggests that it may be possible to develop the reaction into an analytical method for removing F and other halogens from C in volatile fluorocarbons. (auth)

2726

THE REACTIONS OF METALLIC SALTS OF ACIDS WITH HALOGENS; PART I. THE REACTION OF METAL TRIFLUOROACETATES WITH IODINE, BROMINE, AND CHLORINE. R. N. Haszeldine. J. Chem. Soc., 584-7 (1951) Feb.

Ag, Na, K, Hg, Pb, and Ba trifluoroacetates react with I to give trifluoroiodomethane. The interaction of the Ag salt and Br and Cl yields bromo- and chlorotrifluoromethane. Trifluoroiodomethane and heptafluoroiodopropane have also been prepared by pyrolysis of trifluoroacetyl iodide and heptafluorobutyryl iodide in the presence of iodine. (auth)

2727

SOME THERMODYNAMIC PROPERTIES OF HEXADECAFLUOROHEPTANE. George D. Oliver and J. W. Grisard. J. Am. Chem. Soc. 73, 1688-90(1951) Apr.

The heat capacity of hexadecafluoroheptane has been measured over the temperature range 18 to 310°K. A transition that absorbed 1594 ± 1.5 cal/mole was found at 180.46 ± 0.10°K. The triple point, 221.87 ± 0.05°K, and heat of fusion, 1660.5 ± 2 cal/mole, were determined. Vapor-pressure measurements were made for the temperature range −2 to 106°C and are represented by the equation $\log_{10} P_{mm} = 6.96493 - 1196.067/(t + 210.36)$. The calculated heat of vaporization is 7543 cal/mole at a boiling point of 82.50 ± 0.05°. The critical constants are t_c, 201.7°C; P_c, 16.0 atm; and d_c, 0.584 g/ml. Entropy values calculated from these data for the liquid and ideal gas state at 298.16°K are 134.28 ± 0.27 and 158.88 cal/deg mole, respectively. (auth)

2728

A SPECTROPHOTOMETRIC STUDY OF THE HYDROLYSIS PRODUCTS; SOME POSSIBLE COMPLEXES AND METAL SALTS OF FLUOROBORIC ACID. Edward R. Scheffer and Ellwood M. Hammaker. J. Am. Chem. Soc. 72, 5607-9 (1950) Dec.

No indication of complex formation between copper(II), nickel(II), cobalt(II), or chromium(III) and fluoroborate ion was obtained under the conditions studied. The spectral characteristics of two hydroxyfluoroboric acids have been determined. The lack of spectral characteristics in the spectral range covered (approximately the region from 215 to 1200 mμ) has been shown for fluoroboric acid and for several fluoroborates.

LABORATORIES AND EQUIPMENT

2729

Oak Ridge National Lab.
PHYSICS OF SOLIDS NEW HOT LABORATORY; p.95 of QUARTERLY PROGRESS REPORT FOR PERIOD ENDING SEPTEMBER 20, 1950; PHYSICS DIVISION. S. E. Dismuke and D. S. Billington. Jan. 8, 1951. 1p. (ORNL-865(p.95))

The designs of cells 4, 5a, 5b, and 6 are essentially complete. The windows will be filled with zinc bromide solution. Since the cell structure is to be very flexible, the cell walls will be made of high-density concrete blocks held together by a weak mortar. The doors will move on tracks. Cell 4 will have a movable roof. Drawings are included.

2730

Oak Ridge National Lab.
A COBALT GAMMA-RAY SOURCE USED FOR STUDIES IN RADIATION CHEMISTRY. J. A. Ghormley and C. J. Hochanadel. Feb. 6, 1951. 11p. (ORNL-897)

A shield for a high-intensity source of Co^{60} has been designed to meet a number of requirements, most important of which are safety of operation, convenience in setting up and irradiating samples, reproducibility of radiation intensity in the sample, possibility of irradiating under a variety of conditions, and opportunity for making a variety of measurements on samples during irradiation. The shield has been in use several months with a 300-c Co^{60} source and is proving to be extremely useful in studies concerning the effects of ionizing radiation on solids and on water and aqueous solutions.

2731

RADIOCHEMICAL "COLD" LABORATORIES. F. C. Henriques, Jr. Paper presented at a meeting of the Division of Water, Sewage and Sanitation Chemistry, American Chemical Society, Sept. 5-8, 1950.

An abstract of this paper appeared in Pub. Health Engr. Abstracts 31, 6(1951) Mar. and is reproduced here in its entirety.

It is of interest to note that 100 μc, 37,000,000 disintegrations per second, would enable the tracing through any standard chemical experiment of a tagged compound to 1 ppm. This is because it is possible to detect with ease 37 disintegrations per second. Thus 100 μc should suffice for most types of chemical investigations. If one defines a radiochemical "cold" laboratory as a laboratory in which the worker does not handle more than 100 μc of any radioisotope except certain of the long-lived α emitters, no special consideration need be given to the design of the laboratory from a radiochemical viewpoint. In the "cold" laboratory the radioactive isotope must be treated as any poisonous material such as KCN. It has the advantage over an ordinary poison of ease of detection; simple detection equipment such as thin-windowed Geiger tubes should be available for both personnel and area monitoring. It is permissible to admix activity of this level with inactive identical compounds and wash it down the sink. One of the major problems is contamination of the "cold" laboratory, which results from traffic of personnel and equipment that originates in the "hot" laboratory. This can be prevented best by strict enforcement of the following rules: one-way traffic of all supplies from the "cold" laboratory to the "hot" laboratory; and rigid enforcement of monitoring before leaving the "hot" area, where personnel contamination levels must be reduced to appropriate limits, not only for health considerations but also to eliminate the possibility of contamination of subsequent experiments in the "cold" laboratory. (auth)

RADIATION CHEMISTRY

2732

ELEMENTARY PROCESSES IN RADIATION CHEMISTRY; II. NEGATIVE ION FORMATION BY ELECTRON CAPTURE IN NEUTRAL MOLECULES. John L. Magee and Milton Burton. J. Am. Chem. Soc. 73, 523-32(1951) Feb.

Ionization processes characteristic of radiation chemistry yield energetic electrons which are ultimately degraded to thermal energies in ionization and collision processes. Although negative ions can be produced without positive-

ion formation by impact of energetic electrons on molecules, the yield of such processes is so small that they make practically no contribution to the over-all picture. Thermal electrons can yield negative ions either in simple capture or in dissociative capture processes. When conditions for negative-ion formation are satisfactory, low-energy electrons (<⅓ ev in gases, ¼ ev in liquids) disappear almost exclusively in formation of negative ions rather than in neutralization of positive ions. At usual irradiation intensities, common substances which give negative ions by thermal-electron capture include oxygen, liquid water, alcohols, alkyl halides, and, in general, all compounds in states in which they have low-lying vacant orbitals. For capture of thermal electrons in a dissociative process, the electron affinity of the ion produced must exceed the strength of the bond ruptured. In general, such processes tend to increase ion-pair yield, but certain clearly described exceptions exist. Radiation-chemical syntheses of ozone and of H_2O_2 show behavior characteristic of reactions in which the principal neutralization process involves negative oxygen ions. When a negative-ion source (e.g., oxygen or water) is present as impurity in a substance of low-ionization potential (e.g., benzene), the principal neutralization reaction in a radiation-chemical process involves interaction of the negative ion of the former and of the positive ion of the latter. Resultant characteristic reactions may mask the normal radiation-chemical reaction of the uncontaminated principal constituent. Water vapor captures thermal electrons without dissociation, but solvation of the negative ion in liquid water confers large electron affinity and produces a situation conducive to capture accompanied by dissociation. Resultant anisotropic distribution and high concentration of positive and negative ions may have special consequence, particularly in biological systems. (auth)

RADIATION EFFECTS

2733

ACTION OF SOME RADIOACTIVE SUBSTANCES ON THE OXIDATION OF VITAMIN C. I. A. Serebrennikova. Biokhimiya 15, 204-6(1950) May-June. (In Russian)

As an example of effects produced by U compounds on biochemical processes, the influence of uranyl acetate and uranyl nitrate solutions of various activities on the oxidation rate of vitamin C solutions was examined. It was observed that uranyl salts accelerate the oxidation of ascorbic acid; however, this effect is lessened when the activity of the U preparations employed is increased.

2734

CHEMICAL ACTIONS OF IONISING RADIATIONS ON AQUEOUS SOLUTIONS; PART VIII. HYDROXYLATION OF BENZOIC ACID BY FREE RADICALS PRODUCED BY X-RAYS. H. Loebl, Gabriel Stein, and Joseph Weiss. J. Chem. Soc., 405-7(1951) Feb.

The hydroxylation of benzoic acid by free hydroxyl radicals produced by x rays has been investigated. All three isomeric hydroxybenzoic acids were formed, and their relative proportions have been estimated. The formation of salicylic acid has been investigated quantitatively, and its dependence on pH has been determined. (auth)

2735

THE EFFECTS OF RADIATION ON MATERIALS. J. C. Slater. J. Applied Phys. 22, 237-56(1951) Mar.

A detailed survey of the types of damage produced by various kinds of radiation in various solids with relation to the theory of solid-state structure is presented, and types of experiments which have been or could be performed to investigate radiation damage are discussed.

RARE EARTHS AND RARE-EARTH COMPOUNDS

2736

ACTION OF WATER VAPOR ON CERIUM CARBIDE. Jacques de Villelume. Compt. rend. 231, 1497-8(1950) Dec. 18. (In French)

CeC_2 was prepared by heating a mixture of carbon and CeO_2 at 2000°C in a H_2 atmosphere. The product contained 3% free carbon and 27% Ce_2O_3, which amount could not be diminished even by prolonged heating. The action of water vapor from room temperature to 500°C on this product was studied, and the percentages of saturated, olefinic, and acetylinic hydrocarbon gases produced are reported. The percentage of saturated gas is higher than that produced by cold water. A large amount of a brown, porous, infusible, slightly soluble solid also is formed.

2737

THE EXCHANGE REACTION BETWEEN EUROPIUM(II) AND EUROPIUM(III) IONS IN HYDROCHLORIC AND PERCHLORIC ACID SOLUTIONS. Dale J. Meier and Clifford S. Garner. J. Am. Chem. Soc. 73, 1894-5(1951) Apr. (Communication to the editor)

A preliminary report of studies on the measurable exchange rate between Eu(II) and Eu(III) ions in aqueous solutions of HCl and $HClO_4$ is presented. Eu^{152} was used as a tracer. The exchange rate, R, was found to be $R = k[Eu(II)][Eu(VI)][Cl^-]$ and to be independent of H^+ concentration.

2738

HIGHER OXIDES OF THE LANTHANIDE ELEMENTS. TERBIUM DIOXIDE. D. M. Gruen, W. C. Koehler, and J. J. Katz. J. Am. Chem. Soc. 73, 1475-9(1951) Apr.

In an investigation of the comparative chemistry of the lanthanide and actinide elements, atomic oxygen has been used to convert lower oxides of Pr, Tb, and U to PrO_2, TbO_2, and UO_2, respectively. No evidence for higher oxide formation has been obtained with Y, La, Nd, Sm, Eu, Gd, Yb, Hf, and Th. Pure TbO_2 was identified crystallographically and has the fluorite structure with $a_1 = 5.213 \pm 0.002$ A. Evidence for continuous transitions from cubic Pr_2O_3 to PrO_2 and from cubic Tb_2O_3 to TbO_2 has been obtained. The "actinide contraction" observed with +4 actinide compounds is shown to have its counterpart in the lanthanide dioxides. (auth)

2739

ION EXCHANGE MEASUREMENTS OF ACTIVITY COEFFICIENTS AND ASSOCIATION CONSTANTS OF CEROUS

SALTS IN MIXED ELECTROLYTES. Robert E. Connick and Stanley W. Mayer. J. Am. Chem. Soc. 73, 1176-9 (1951) Mar.

Ion-exchange equilibria between Dowex 50 resin and an aqueous solution containing a small concentration of cerous ion and a relatively large concentration of $HClO_4$, $NaClO_4$, HCl, HNO_3, or Na_2SO_4 have been measured with Ce^{141}-Ce^{144} fission-product mixture as tracer. Relative values of activity coefficients of the cerous salts were calculated from the data. Deviations of the activity coefficients of cerous chloride and nitrate from that of cerous perchlorate have been interpreted in terms of complex-ion formation. Sulfate ion was shown to complex cerous ion fairly strongly in 0.5 molal $NaClO_4$; the first complexing constant is approximately 60. (auth)

2740

OXIDATION OF SOME RARE EARTH OXIDES WITH OZONE. Sherman Rabideau and George Glockler. J. Am. Chem. Soc. 73, 488(1951) Jan. (Note)

In an attempt to produce the maximum oxidation state of Pr, Nd, Sm, and Gd, the dry oxides were subjected to the action of ozone at room temperature and at atmospheric pressure. Only in the case of the oxides of Pr was an oxidation by ozone observed. Both the sesquioxide and the higher oxide, Pr_6O_{11}, reacted with ozone to form the dioxide. Results of the oxidations of the two oxides of Pr with ozone are tabulated.

SEPARATION PROCEDURES

2741

Argonne National Lab.
ABSORPTION OF INORGANIC SALTS FROM ORGANIC SOLVENTS ONTO ANION EXCHANGE RESINS. (abstract) Leonard I. Katzin, Elizabeth Gebert, and James C. Sullivan. Jan. 18, 1951. 6p. (AECU-1154; UAC-341)

The solutes HCl, LiCl, $CoCl_2$, $Co(NO_3)_2$, $CuCl_2$, and $Ni(NO_3)_2$ have been found to absorb onto anion-exchange resins (Dowex A-1) from their solutions in acetone. The absorption is characterized by disappearance of the molecule as a whole from the liquid phase rather than by ion exchange. Detailed study with Co^{60}-tracer-labeled $Co(NO_3)_2$ and $CoCl_2$ and both chloride and nitrate forms of the resin have shown that at least the following factors are involved: (a) nature of the anion associated with the cation in solution; (b) nature of the anion associated with the resin; (c) the water content of the starting resin or of the total system. Although it seems likely that a reaction which may be written $R^+A^- + MA_3 = R^+(MA_3)^-$ is one of those involved in the case of the transition-element salts (R^+, resin cation; A^-, anion; M^{+3}, transition-element cation, solvation ignored), establishment of the importance of this absorption reaction relative to other possible reactions, especially for cases like LiCl, has not yet been accomplished. (auth)

2742

CHEMICAL ANALYSIS OF MONAZITE AND MONAZITIC SANDS. Oswaldo Erichsen de Oliveira. Anais assoc. quím. Brazil 9, 65-74(1950). (In Portuguese)

A description is given of the chemical analysis of monazites and monazitic sands, in which the first operation is a fusion with KHF_2. The rare earths and Th can then be separated as insoluble fluorides from P, Ti, Fe, Zr, Al, K, etc.

2743

DISTRIBUTION OF URANYL NITRATE BETWEEN ETHER AND WATER PHASES. A PRELIMINARY STUDY. Hans-Christian Neeb. In Forsvarets Forskningsinstitutt, Årbok II, 1948-49, 363-72. (In Norwegian)

In order to determine optimal conditions for ether extractions of uranyl nitrate from aqueous solutions, the distribution coefficient between ether and water phases was measured at various concentrations and in the presence of other nitrates or HNO_3. The yields of ether extractions grow with the NO_3^- ion concentration in the aqueous layer; among Al, Ca, Th, and NH_4 nitrates, all of which further the U extraction, $Ca(NO_3)_2$ is to be preferred; free HNO_3 should be present in small concentrations only.

2744

ESTIMATION AND SEPARATION OF ZIRCONIUM BY USE OF FUMARIC ACID. M. Venkataramaniah and S. V. Raghava Rao. Analyst 76, 107-9(1951) Feb.

Fumaric acid precipitates Zr completely from solutions up to 0.35N in HCl. The precipitate, which has the approximate composition O = Zr = X (where X stands for the fumarate radical), is gelatinous and is ignited to give the oxide. From solutions 0.25N in HCl the reagent separates Zr from Al, Be, U, Ni, Ba, Ca, Fe, Mn, Th, and the ceria earths in a single precipitation; V, Cr, Ti, and Sn are completely removed in a double precipitation. Zr has also been estimated in zircon. (auth)

2745

FURTHER STUDIES OF THE ION-EXCHANGE SEPARATION OF THE RARE EARTHS. B. H. Ketelle and G. E. Boyd. J. Am. Chem. Soc. 73, 1862-3(1951) Apr. (Note)

A correction in previous work (Ketelle and Boyd, J. Am. Chem. Soc. 69, 2800(1947)) on ion-exchange-column separation of activities produced by neutron irradiation of Gd_2O_3, Dy_2O_3, and Eu_2O_3 includes correction of mislabeled Tb and Y activity peaks. Further discussion and argumentation are included.

2746

SEPARATION OF ULTRAMICRO QUANTITIES OF ELEMENTS BY ELECTRODEPOSITION. L. B. Rogers. Anal. Chem. 22, 1386-7(1950) Nov.

The practical considerations involved in devising a quantitative electroseparation of submicrogram or tracer amounts of elements are discussed. (auth)

SPECTROSCOPY

2747

STRUCTURE AND ZEEMAN-EFFECT IN THE SPECTRUM OF THE TANTALUM ATOM Ta I. P. F. A. Klinkenberg and G. J. Van Den Berg. Physica 16, 861-89(1950).

The analysis of existing wavelength data of the Ta I spectrum has resulted in the detection of 6 ground levels and numerous higher terms, in addition to those reported by previous investigators. The total number of classified lines is now 687. They correspond to combinations between 19 even ground levels and 98 odd high levels. The Zeeman effect is investigated in the region 2500 to 8500 A, and for practically all levels the g values can be determined. The low terms belong to the configurations $5d^36s^2$ and $5d^46s$; no levels of $5d^5$ could be detected. The odd levels originate in the configurations $5d^36s^26p$, $5d^36s6p$, and $5d^46p$, the most important multiplets of which can be identified. (auth)

SYNTHESES

2748

Argonne National Lab.
METHODS OF PREPARING FORMALDEHYDE—C^{14}. A. R. Van Dyken. Apr. 1950. 34p. (ANL-4438)

A number of different approaches to the problem were explored, beginning with attempts to accomplish the direct reduction of CO_2 to formaldehyde in acceptable yield. Thereafter a variety of indirect methods were considered, of which the most promising appeared to be one making use of the thermal decomposition of methyl triphenylmethyl ether into triphenylmethane and formaldehyde. This process was carried through to the stage of experimental trials with radioactive materials at tracer levels of activity. Results of these trials throw some light on the mechanism of the pyrolytic decomposition.

2749

APPARATUS FOR THE PREPARATION OF ANHYDROUS TITANIUM(III) CHLORIDE AND TITANIUM(III) BROMIDE. J. M. Sherfey. J. Research Natl. Bur. Standards 46, 299-300(1951) Apr.

An improved method is described for the preparation of $TiCl_3$ or $TiBr_3$ from the corresponding tetrahalide. The apparatus consists essentially of a reaction kettle, in the upper half of which is suspended a hot tungsten filament. A mixture of H_2 and the vapor of the refluxing tetrahalide reacts at the surface of the filament, and the resulting solid product collects at the bottom of the vessel. (auth)

2750

COBALT 60 LABELED VITAMIN B_{12} OF HIGH SPECIFIC ACTIVITY. Charles Rosenblum and D. T. Woodbury. Science 113, 215(1951) Feb. 23. (Communication)

Starting with Co^{60} of specific activity 1.800 μc/mg added to a nutrient medium (broth), the authors have obtained a product with a specific activity of ~67 μc/mg. The highest specific activity expected was 72 to 81 μc/mg, depending on the value (4 or 4.5%) taken for the Co content of vitamin B_{12}. Despite the uncertainty in the Co content of vitamin B_{12}, it appears that the added Co is utilized by the microorganism, and that only 7 to 17% of the Co that was incorporated in the radioactive vitamin originated in the raw broth.

2751

INVESTIGATION OF THE DEUTEROHALOFORM SYNTHESIS. A NEW PREPARATION OF CHLOROFORM-d. W. M. Boyer, R. B. Bernstein, T. L. Brown, and V. H. Dibeler. J. Am. Chem. Soc. 73, 770-2(1951) Feb.

Isotopically pure $CDCl_3$ is not obtained by the reaction of chloral with sodium deuteroxide. The observed $CHCl_3$ dilution of the product does not occur through the previously advanced mechanism of protium exchange with the solvent. A new synthesis of chloroform-d by the reaction of trichloroacetophenone with sodium deuteroxide has produced $CDCl_3$ of 99.2% isotopic purity. (auth)

2752

A NEW SYNTHESIS OF CHLOROFORM-d. Mason H. Earing and John B. Cloke. J. Am. Chem. Soc. 73, 769-70 (1951) Feb.

Chloroform-d has been prepared in good yield by the action of deuterium oxide on anhydrous calcium trichloroacetate. The infrared absorption spectrum of the product has been measured, and the purity has been quantitatively determined both by this means and by the density increment. (auth)

TRACER APPLICATIONS

2753

PREPARATION OF C^{14}-CYANIDE FROM C^{14}-CARBONATE. J. A. McCarter. J. Am. Chem. Soc. 73, 483(1951) Jan. (Note)

A procedure is described based on the fact that KCN can be obtained by passing ammonia over hot iron and then over a hot mixture of K_2CO_3 and Zn dust. An average yield of 90% of theory is reported.

2754

THE DECARBONYLATION OF DIPHENYL TRIKETONE. John D. Roberts, Donald R. Smith, and C. C. Lee. J. Am. Chem. Soc. 73, 618-25(1951) Feb.

The $AlCl_3$-, cupric acetate-, and NaOH-induced decarbonylations of diphenyl triketone have been shown by C^{14}-tracer studies to result in loss of the center carbonyl group. The cupric acetate–induced decarbonylation of p-methoxyphenyl phenyl triketone was found to proceed in a similar manner. The benzilic acid–type rearrangement of p-methoxybenzil has been found to involve preferential migration of the phenyl group. (auth)

2755

THE EXCHANGE REACTION BETWEEN HYDROGEN CHLORIDE AND CHLORINE IN THE GASEOUS STATE. W. H. Johnston and W. F. Libby. J. Am. Chem. Soc. 73, 854-5(1951) Feb. (Note)

Details of the reaction, studied with Cl^{36} tracer, are described. It is reported that the homogeneous exchange is slow and is catalyzed by ordinary glass surfaces, and that a rapid photochemical exchange reaction occurs. Experimental data on a dark-exchange reaction and on the quantum yield for the photoexchange are tabulated.

2756

HYDROGEN-DEUTERIUM EXCHANGE ACTIVITY OF SILICA-ALUMINA CATALYSTS. V. C. F. Holm and R. W. Blue. Ind. Eng. Chem. 43, 501-5(1951) Feb.

The reaction, $H_2 + D_2 - 2HD$, is generally believed to proceed by dissociation of molecules into adsorbed "atoms" and recombination into new molecules. A series of coprecipitated silica-alumina catalysts has been tested for this reaction to see whether adsorbed H atoms could play an important role in a hydrogen-transfer reaction. Catalysts in the composition range 0 to 7.5% silica have the highest activity for H−D exchange, whereas those in the range 60 to 90% silica are best for H transfer. The results show that H transfer and H−D exchange are different in nature and require different characteristics in a catalyst. Pretreatment of catalysts at 800 instead of 400°C increased the activity for H−D exchange a thousandfold in some instances, probably as a result of elimination of water. Even when pretreated at the higher temperature, however, the most active silica-alumina catalysts were much less active than a catalyst commonly used for dehydrogenation. (auth)

2757

OXYGEN EXCHANGE AS EVIDENCE FOR THE EXISTENCE OF AN INTERMEDIATE IN ESTER HYDROLYSIS. Myron L. Bender. J. Am. Chem. Soc. 73, 1626-9(1951) Apr.

Ethyl benzoate, i-propyl benzoate, and t-butyl benzoate have been labeled in the carbonyl group with O^{18}. The kinetics of the hydrolysis of these esters, and of the oxygen exchange accompanying hydrolysis, have been determined. The fact that oxygen exchange occurs in every case between the carbonyl oxygen of the ester and the solvent during the process of hydrolysis strongly suggests that a true intermediate, in which the carbonyl oxygen participates in a reversible fashion, occurs during the hydrolysis. The most probable structure of this intermediate must include a contribution from the un-ionized hydrate of the ester, $C_6H_5C(OH)_2(OR)$, since the intermediate must assume a symmetrical structure capable of exchange. In 33% dioxane k_h/k_e (hydrolysis rate constant/exchange rate constant) for ethyl benzoate is 10.6; for i-propyl benzoate it is 3.7; for t-butyl benzoate it is 7.6. The similarity of k_h/k_e for these three esters and the virtual identity of k_h/k_e for both the acid and alkaline hydrolysis of ethyl benzoate suggest a similar intermediate in all cases. (auth)

2758

PROCEDURE FOR COLLECTION OF ISOTOPIC NITROGEN. W. R. Vaughan, W. T. Boyd, D. I. McCane, and G. J. Sloan. Anal. Chem. 23, 508-11(1951) Mar.

The work was undertaken to develop a convenient method for direct comparison of N^{15} enrichment in nitrite and ammonium ions. The technique resembles the Dumas procedure for ultimate N analysis, and the procedure has been worked out in detail for the reaction, $NH_4^+ + NO_2^- \rightarrow N_2 + 2H_2O$. Obvious extensions to other N-producing reactions, such as selective deamination or the Dumas combustion, are discussed, and suggestions for suitable modifications are made. Such adaptations will make possible more extensive comparisons of N^{15}-enriched compounds, particularly of organic compounds with inorganic sources or inter se, than are now convenient because of the requirement that N be obtained as NH_4Cl for analysis, and the procedure should broaden the field of study by means of tracer N^{15}. The apparatus is inexpensive and simple to operate, and the limiting factor of accessibility of a mass spectrometer should offer little difficulty. (auth)

2759

THE REACTION OF 9-FORMYLFLUORENE-10-C^{14} WITH FORMALDEHYDE. John G. Burr, Jr. J. Am. Chem. Soc. 73, 823(1951) Feb.

The reaction of 9-formylfluorene-10-C^{14} with aqueous formaldehyde has been found to produce nonradioactive 9-fluorenemethanol. The radioactivity was accounted for quantitatively as formate ion. These facts are explained by a mechanism which includes as an intermediate the aldol formation of an unstable tertiary aldehyde.

2760

THE RECENT APPLICATIONS OF THE RADIOACTIVE ISOTOPES FOR CHEMICAL RESEARCHES. Shizuo Ueda and Kazuo Nishizawa. Bull. Inst. Chem. Research Kyoto Univ. 23, 7-14(1950) Dec. (In Japanese)

A summary is presented of recent applications of radioactive isotopes to chemistry. Methods of preparation and synthesis of labeled dl-cystine, l-serine, nitrosopteroylglutamic acid, and many other inorganic and organic compounds are presented. A discussion is given of self-adsorption curves, methods of measurement of radioactivity, and microanalysis by radiochemical methods. The radiochemical determination of the lower solubilities, e.g., that of Th pyrophosphate (6.1×10^{-6} g/liter), etc., are discussed. Note is made of the use of isotopes in the determination of the mechanism of chemical and exchange reactions. The determination of surface area, measurement of low vapor pressures, determination of ionic transference number in molten salts, and the measurement of the diffusion coefficient of Cu in the oxidation of Cu foil are discussed.

2761

SELF-DIFFUSION AND STRUCTURE OF LIQUID WATER. I. MEASUREMENT OF SELF-DIFFUSION OF LIQUID WATER WITH DEUTERIUM AS TRACER. J. H. Wang. J. Am. Chem. Soc. 73, 510-13(1951) Feb.

A method for measuring self-diffusion of liquids by means of capillaries is described; the accuracy of this method is within about 1%. The self-diffusion coefficients of liquid water in the temperature range 0 to 55°C have been determined by both the capillary method and the usual diaphragm cell method with deuterium as tracer. Data of the present work support the quasi-crystalline structure of liquid water and are in contradiction with the assumed existence of definite species of associated water molecules in liquid water. The average apparent activation energy, 4.58 kcal/mole, for self-diffusion of liquid water in the temperature range 10 to 50°C indicates that water in this temperature range is only very slightly more than two-coordinated. Below 5°C, however, the apparent activation energy of self-diffusion increases appreciably as temperature drops, reaching the approximate value of 6.4 kcal/mole at 0°C. (auth)

2762

SOME ASPECTS OF THE BEHAVIOR OF CARRIER-FREE TRACERS—II. Norman A. Bonner and Milton Kahn. Nucleonics 8, 40-61(1951) Mar. (See also NSA 5-1520)

Deposition of carrier-free tracers on ionic precipitates, charcoal, and ion-exchange resins is discussed. Oxidation-

reduction reactions, ion charges, and tracer-to-macro extrapolation are analyzed. Schematic diagrams of the electric double layer on charged AgI particles, a graph showing the adsorption of ThB (Pb^{212}) on negatively charged AgBr, tabular data on the adsorption of ThB on AgBr and on oxidation potentials obtained from critical deposition potentials, and other appropriate relations and data are included. 93 references.

2763

STABLE AND UNSTABLE ISOTOPES IN CATALYTIC RESEARCH. John Turkevich, Francis Bonner, Donald Schissler, and Peter Irsa. Discuss. Faraday Soc., No. 8, 352-6(1950).

A discussion is given of the advantages and disadvantages of the use of stable and unstable isotopes in catalytic research. The application of C^{14} to the study of the reduction of CO_2 by charcoal is presented. The results of the use of H^3 for the study of the catalytic double-bond migration are cited as evidence for the theory of a hydrogen-switch mechanism. A discussion is given of the use of deuterium and mass spectrometry to determine the number and position of the D atoms in molecules containing varying amounts of D. This use of the stable isotope of hydrogen is illustrated by examples of the analysis of the reaction of ethylene and D on a nickel-wire catalyst. (auth)

TRANSURANIC ELEMENTS AND COMPOUNDS

2764

Argonne National Lab.
OXIDATION-REDUCTION REACTIONS OF Np(IV) and Np (V). J. R. Huizenga and L. B. Magnusson. Aug. 4, 1950. 20p. (AECD-3056; ANL-WMM-685)

The results of studies at 25°C of the oxidation of Np(IV) by ferric ion in perchlorate solutions over the range 0.25M to 1.0M hydrogen ion are presented. The course of the reaction was followed spectrophotometrically by observing the decrease in optical density of the Np(IV) 722-mμ absorption band. No evidence has been found of any perchlorate complexing of Np(IV); so the ion is assumed to be Np^{+4} in perchlorate solutions. Since the hydrolysis constant of ferric ion is about 10^{-2}, the principal species is Fe^{+3}. The overall reaction is $Np^{+4} + Fe^{+3} + 2H_2O = NpO_2^+ + Fe^{++} + 4H^+$. The final formulation of the rate law in perchlorate solution is $d(Np^{+4})/dt = k_1(Np^{+4})\,(Fe^{+3})/(H^+)^3$ at 25°; $\mu = 1.0$; $k_1 = 2.7$ moles^3/liter^2/min^1. The rate-determining step may be postulated as $Np(OH)_y^{+4-y} + Fe(OH)_w^{+3-w} \rightarrow NpO_2^+ + Fe^{++} + H_2O + H^+$. The Np(IV)-Fe(III) reaction was also studied in nitrate solutions. This situation is more complicated since Np^{+4} is complexed by nitrate ion. The observed nitrate rate constants are smaller than the corresponding perchlorate rate constants and, hence, are in qualitative agreement with the predicted rate decrease from nitrate complexing, but the calculated nitrate constants are too large by 40%. The present experimental evidence furnishes no explanation for the apparent inconsistency between the degree of complexing and change in rate constant. It is possible that the rate-determining step may go more rapidly in nitrate solution. Another explanation may be that the Np nitrate complexes hydrolyze to reacting species.

2765

OXIDATION POTENTIALS OF THE Pu(III)-Pu(IV) AND Fe (II)-Fe(III) COUPLES IN PERCHLORIC ACID SOLUTION—HEAT CONTENT AND ENTROPY CHANGES. Robert E. Connick and William H. McVey. J. Am. Chem. Soc. 73, 1798-1804(1951) Apr.

The formal potential of the cell Pt:H_2:1M $HClO_4$, $Pu(ClO_4)_3$, $Pu(ClO_4)_4$:Au was found to be −0.982 volt at 25°C. This value differs significantly from that previously reported and is consistent with the idea that Pu^{+4} is partly complexed by chloride ion in 1M HCl. A formal potential scheme involving the +3, +4, and +6 oxidation states of Pu in 1M $HClO_4$ was derived. The emf was measured as a function of temperature, and the change in heat content for the reaction $Pu^{+3} + H^+ = Pu^{+4} + \frac{1}{2}H_2$ was found to be +13.52 kcal/mole, compared with 13.3 kcal/mole obtained by Evans ("The Transuranium Elements," New York, McGraw-Hill, 1949, p.282) from calorimetric measurements. Approximate entropy values for the ions Pu^{+4} and PuO_2^{++} were found to be −77 and −18 units, respectively. These are very nearly equal to those for the corresponding ions of U. The heat and free energy of the reaction $Fe^{++} + H^+ = Fe^{+3} + \frac{1}{2}H_2$ were measured and compared with previously determined values. (auth)

2766

THE PREPARATION OF ANHYDROUS AMERICIUM COMPOUNDS. Sherman Fried. J. Am. Chem. Soc. 73, 416-18 (1951) Jan.

By use of techniques developed in the studies of the chemistry of the other heavy elements, it has been possible to prepare and identify several simple compounds of americium. With the exception of the dioxide, AmO_2, the compounds of americium prepared were in the III oxidation state, and the formulas AmF_3, $AmCl_3$, $AmBr_3$, AmI_3, and Am_2S_3 may be considered analogous to the corresponding compounds of the rare-earth series. A detailed description of the techniques and a qualitative discussion of the properties of americium are presented. (auth)

URANIUM AND URANIUM COMPOUNDS

2767

Battelle Memorial Inst.
URANIUM SESQUICARBIDE. M. W. Mallett, A. F. Gerds, and D. A. Vaughan. Jan. 31, 1950. Decl. Feb. 14, 1950. 17p. (AECD-3060; BMI-T-19)

The sesquicarbide of U, U_2C_3, has been found to exist as a stable compound below about 1800°C. At higher temperatures, it decomposes into UC and UC_2. It has not been produced directly from the melt but only by heating a mixture of UC and UC_2 between 1250 and 1800°C. A slight amount of stressing, even as little as that incidental to handling a specimen, is necessary to initiate the reaction. An experimentally determined density of 12.7 g/cc agrees very well with a density of 12.88 g/cc calculated from x-ray data. The crystal structure of the compound had been found to be body-centered cubic, having a space group symmetry I-43D and a unit-cell dimension of $a_0 = 8.088 \pm 0.001$ A. (auth)

2768

Carbide and Carbon Chemicals Corp., Y-12 Area
DISSOLUTION OF URANIUM TETRAFLUORIDE. V. P. Calkins; revised by C. D. Susano. Apr. 1, 1947. Revised Oct. 3, 1949. 10p. (AECD-3064; H-1.740.8(paper 12))

Five new dissolution processes for UF_4 are discussed: the $NH_4OH-H_2O_2$ method, the $H_2SO_4-(NH_4)_2S_2O_8$ method, the $AlCl_3$ method, the $NaAlCl_4$ method, and the $Al(NO_3)_3 \cdot 9H_2O$ method. It is concluded that $NaAlCl_4$ and $Al(NO_3)_3 \cdot 9H_2O$ are preferable to the other agents, especially with regard to rate of dissolution and ease of manipulation. (auth)

2769

Oak Ridge National Lab.
THE URANYL FLUORIDE–WATER SYSTEM. W. L. Marshall, J. S. Gill, and C. H. Secoy. Dec. 15, 1950. Decl. Feb. 14, 1951. 15p. (AECD-3069; CF-51-1-82)

A phase study of the liquid-solid equilibria in the uranyl fluoride–water system from the ice eutectic at −13°C to the critical temperature of the saturated liquid at 377°C is presented. Some observations on vapor-liquid equilibria are included, and their significance is discussed. The system displays three solid phases stable with respect to the saturated solution in the temperature ranges −13 to 150°C, 150 to 240°C, and above 240°C, respectively. There is some evidence to indicate that these solids are all allotropic modifications of uranyl fluoride dihydrate, but this is not certain. A two-liquid-phase region occurs at all concentrations from a very dilute solution up to approximately 70.5 wt % UO_2F_2. The lower temperature limit of the two-liquid-phase region is at the minimum critical solution temperature of 313°C, and the upper limit is the temperature of the invariant system, Solid–Liquid I–Liquid II–Vapor (347°C). The vapor-liquid critical temperature of the water-rich liquid phase saturated with respect to the high-temperature solid is 377°C, thus indicating a significant but small solubility in the critical fluid. Values for the acidity and density of aqueous solutions of uranyl fluoride at 25°C are also presented as functions of the concentration. (auth)

2770

Argonne National Lab.
DISSOCIATION PRESSURES OF URANIUM HYDRIDE AND URANIUM TRITIDE. H. E. Flotow and B. M. Abraham. Jan. 5, 1951. Decl. Jan. 30, 1951. 9p. (AECD-3074; ANL-WMM-759; ANL-WMM-760)

The measured dissociation pressures of UH_3 over the temperature interval 300 to 420°C and of four UH_3-UT_3 mixtures over the temperature interval 320 to 390°C are reported. The dissociation pressures of UH_3 are accurately represented by the equation $\log P_{mm} = \frac{-6270.1}{T} - 6.0146 \log T + 28.9235$ and are in satisfactory agreement with those reported by Spedding et al. (Nucleonics 4, 10(1949)). For the mixtures, an ionization chamber built into the apparatus was used to determine the T/H ratio in the gas; from this analysis, the composition of the solid phase was determined by difference. The logarithms of the partial pressures of H_2 and T_2 molecules, calculated from the data and the equilibrium constant for the reaction $H_2 + T_2 = 2HT$, are linear functions of the mole fractions of the respective components in the solid at constant temperature. By extrapolating to mole fraction equal 1, the dissociation pressures of pure UH_3 and pure UT_3 are obtained. The dissociation pressures for UH_3 so obtained are in good agreement with those calculated from the preceding equation; the dissociation pressures for UT_3 are represented by the equation $\log P_{mm} = \frac{-4471}{T} + 9.461$. The dissociation pressure is 1 atm at 430°C for UH_3 and at 406°C for UT_3. The heats of dissociation at these temperatures are 20.3 kcal/mole H_2 and 20.5 kcal/mole T_2. (auth)

ENGINEERING

2771

Oak Ridge National Lab.
GENERAL WELDING GUIDES. A. R. Olsen. Nov. 10, 1950. 7p. (CF-50-11-64)

A compilation of various recommendations governing the welding of stainless steel is presented.

HEAT TRANSFER AND FLUID FLOW

2772

Columbia Univ. and Brookhaven National Lab.
HEAT AND MOMENTUM TRANSFER IN TURBULENT FLOW OF MERCURY. Sheldon E. Isakoff and Thomas B. Drew. [nd.] 25p. (AECU-1199)

It is found experimentally for mercury flowing vertically in a 1.5-in. tube in the Reynolds modulus range 36,700 to 373,000 that the ratio of the eddy diffusivity for heat to that for momentum varies directly with the 0.46 power of the Reynolds modulus and as a function of relative position in the cross section that is independent of Reynolds modulus. The velocity profiles for mercury agree essentially with those for other fluids. The temperature profiles are at variance with the predictions of Martinelli (Trans. Am. Soc. Mech. Engrs. 69, 947(1947)). The heat-transfer coefficients, although well approximated by the Martinelli-Lyon equations, increase more rapidly than those equations predict. (auth)

2773

Columbia Univ.
HEAT TRANSFER BY NATURAL CONVECTION FROM HORIZONTAL CYLINDERS TO LIQUID METALS; FIRST QUARTERLY PROGRESS REPORT FOR JULY 1, 1950, TO SEPTEMBER 30, 1950. Seymour C. Hyman, Stanley W. Ehrlich, Shih J. Wang, and Charles F. Bonilla. Sept. 30, 1950. 19p. (NYO-561)

Data have been obtained with a long thermocouple junction on which a temperature gradient was impressed. The graphically averaged temperature over the junction agrees closely with that obtained by distant connections normal to the thermocouple junction, indicating that the surface-averaging thermocouples used in this study are reliable. Additional natural-convection heat-transfer data from horizontal cylinders 0.25 to 1.5 in. diam agreed with the correlation for initiation of turbulent flow previously reported (NYO-558, NSA 4-3429; NYO-559, NSA 4-4877) for 0.5-in. cylinders. (auth)

2774

California Univ., Berkeley
INVESTIGATION OF CONVECTIVE HEAT TRANSFER IN SYSTEMS IN WHICH LIQUID LEAD-BISMUTH ALLOY IS USED AS THE MEDIUM; QUARTERLY PROGRESS REPORT; 1 SEPTEMBER TO 30 NOVEMBER 1950. H. A. Johnson. Jan. 10, 1951. 21p. (ORO-23)

The 3/4-in. Cu-jacketed steel tube for which Pb-Bi heat-transfer coefficients have been reported previously was tested with deaerated water at 150°F to determine the combined thermal resistance due to fouling and copper-steel bonding. The observed stated deviations compared with the instrumentation accuracy, and the fact that the thermal resistances tended to increase after cleaning is believed evidence that the Cu-to-steel bond was unstable and progressively poor with use. Consequently, adjustment of the original Pb-Bi heat-transfer data is not possible. These tests have demonstrated some promise for the water-testing technique as a means of validating the extrapolation method necessary for establishing the tube inside-surface temperature. The design of the new loop for measurement of the heat-transfer coefficient of Pb-Bi eutectic in turbulent pipe flow at temperatures up to 1000°F and Peclet numbers up to 12,500 is being continued. The possibility of using the loop for Hg is still being considered. The design status and multiplications of the loop components are summarized. Bailey's analysis (ORNL-521) for heat transfer to fluids flowing in annular spaces was modified as indicated in the previous report, and calculations have been carried out for Prandtl numbers from 1.0 to 10.0, Reynolds numbers from 10^4 to 10^5, and diameter ratios of 1.5, 2.0, 3.0, and 3.6. This was done for the two cases of heat flow into the exterior with the interior wall adiabatic and heat flow into the interior with the exterior wall adiabatic.

2775

INVESTIGATIONS OF AXIAL-FLOW COMPRESSORS. J. T. Bowen, R. H. Sabersky, and W. D. Rannie. Trans. Am. Soc. Mech. Engrs. 73, 1-15(1951) Jan.

An approximate theory of the general perfect fluid flow in axial turbomachines is presented. The validity of the simplifying assumptions of the theory is justified by comparison with flow patterns measured in a large, low-speed, axial-flow compressor. It is concluded that the theory is convenient to apply and is sufficiently accurate for most engineering purposes. Performance data on blading designed for two- and three-dimensional flow show that the blade types have comparable efficiencies. It is suggested that the advantages of unconventional blade types be exploited by designers. The flow regions in which fluid viscosity is important are shown. Experimental studies of cascade losses in the compressor indicate these losses to be greater than those measured in a cascade test tunnel. Measurements show that the rate of growth of the wall boundary layer need not be unusually great in an axial-flow compressor. (auth)

2776

Massachusetts Inst. of Tech.
STATEMENT OF PROGRESS FOR THE PERIOD 1 JANUARY 1951 TO 12 FEBRUARY 1951. John A. Clark. Feb. 12, 1951. 11p. (NP-1659)

Low-velocity heat-transfer data in the boiling and nonboiling regions were accumulated at 2000 psia. These are reported for velocities of 1.4, 0.8, 0.52, and 0.20 fps and for fluid bulk temperatures ranging from 300 to 600°F. Data were also taken at velocities of 0.3, 0.25, 0.1, 0.08, 0.06, and 0.04 fps; these data have not yet been reduced. Research on the selection of window glass for the high-pressure visual test section, where the glass must support a pressure difference of 2000 psi while maintaining its optical properties with one face in contact with H_2O at temperatures as high as 636°F, has led to a satisfactory selection. Attempts to find a means of bonding mica to glass were unsuccessful and, in view of the preceding, unnecessary. It is doubtful whether the mica itself is any more resistant to surface attack by water than the best glasses. The status of equipment construction is summarized.

MATERIALS TESTING

2777

Knolls Atomic Power Lab.
THERMAL STRESSES IN PERFORATED PLATES. G. Horvay. Jan. 29, 1951. 83p. (KAPL-P-456)

A method is developed for the analysis of perforated plates of triangular layout, when loading occurs in the plane of the plate. The method is applied to the calculation of stresses and distortions that result in a tube sheet when the temperature of the sheet is lowered below the temperature of the supporting shell. (auth)

2778

CHANGE OF THE ELASTIC LIMIT OF AN ALUMINIUM ROD BY ELONGATING PLASTICALLY AND BY ANNEALING. Miyabi Sugihara. Mem. Coll. Sci. Univ. Kyoto 22A, 195-207(1939) May.

A cold-worked aluminum rod heated to a relatively high temperature has a small elastic limit. When such a rod is cold-worked at various degrees by stretching and by drawing through dies, the elastic limit increases, at first rapidly and then slowly. When the rod thus cold-worked is heated again, the elastic limit increases at a relatively low temperature and decreases at a relatively high temperature with increase of the annealing time.

2779

CREEP OF HIGH-PURITY ALUMINUM. William D. Jenkins. J. Research Natl. Bur. Standards 46, 310-17(1951) Apr.

A study was made of cold-drawn Al at 105°F to determine the effects of variations of creep rate on the mechanism of deformation. Strain-hardening was found to decrease monotonically with increase in strain during first stage of creep. The extension on loading and the extension at the beginning of the third stage both increased with increase in stress. Cyclic temperature changes appeared to increase the ductility. Discontinuous flow was evidenced in constant-load creep tests at 105°F and in tensile tests conducted at 80°F. Conformance to Andrade's law of transient flow was found within a limited range of strain rates. Sigmoidal curves were produced that depicted the relation between stress and creep rate. A mechanism of flow based on observed structural changes is proposed. 11 figures. (auth)

2780

PHOTO-ELASTIC METHOD FOR DETERMINATION OF STRESS IN POWDERED MASS. Takao Wakabayashi. J. Phys. Soc. Japan 5, 383-5(1950) Sept.-Oct.

A method is reported for measuring stresses in a powdered mass through variations in the refractive index based on the fact that, when sand of transparent materials such as glass is immersed in a liquid medium whose refractive index is identical to the sand, it becomes transparent for the light within a certain range of wavelength. An experiment using a vessel provided with two windows of thick plate glass on both sides, sand of glass, and a solution of carbon disulfide and benzene is described. A load is applied and measured through a ring-shaped test piece of Phenolite on the surface of the sand.

MINERALOGY, METALLURGY, AND CERAMICS

CERAMICS AND REFRACTORIES

2781

HIGH-REFRACTORY OXIDE CRUCIBLES WITHSTAND 2500°C HEAT. Tech. Data Dig. 16, 3-5(1951) Feb.

Development of a series of sintered pure metallic oxides, which have no porosity, are chemically and physically very stable even at high temperatures (2500°C), and have excellent resistance against corrosion, is reported. Descriptions of the preparation of alumina crucibles from aluminum oxide powder using a plaster of Paris mold and preparation of oxide shapes for sintering by extrusion are included.

GEOLOGY AND GEOPHYSICS

2782

DISTRIBUTION OF OXYGEN ISOTOPES IN THE LITHOSPHERE. Peter Baertschi. Helv. Phys. Acta 23, 536-7 (1950) Sept. 1. (In German)

This work was inspired by that of Urey et al. on the temperature dependence O^{18} and O^{16} distribution between water and carbonates and on the possible use of those data for the determination of temperatures in the geologic past (J. Chem. Soc., 562(1947); Science 108, 489(1948); J. Chem. Phys. 18, 849(1950)). The author's aim was an estimate of the O^{18} abundance in the oxygen of the primordial molten mass and of the redistribution of that isotope between oceans and sediments which came into being after the formation of the crust. The method used was a comparison of O^{18}/O^{16} ratios in samples of oxygen obtained from various substances through reactions illustrated by the following example: $2CaSiO_3 + 4ClF_3 - 2CaF_2 + 2SiF_4 + 2Cl_2 + 3O_2$. Since it can be assumed that no O isotope exchanges took place in the molten state of the earth, the present O^{18} abundance in igneous rocks is equal to the original one. Granite, basalt, and modern lava show small deviations (0.2%) of the ratio about a value that is found to be 0.7% higher than that corresponding to ocean water; on the other hand, silicate sedimentary rocks (sandstones, schists) are enriched, relative to igneous rocks, by the same mean value of 0.7%. The geologic destiny of O^{18} becomes clear if the fact is taken into consideration that there are equal absolute quantities of oxygen both in the hydrosphere and in the silicate-sediment mantle of the earth's crust.

2783

Saratoga Springs Commission
INFORMATION ON RADIOACTIVE SPRINGS. Walter S. McClellan, comp. [nd.] 16p. (NP-1967)

Amounts of radioactivity reported in hot springs and spas throughout the world have been assembled on a geographical basis. The reported amounts of radioactivity in mineral waters vary considerably with the methods employed. Many of the reports on the springs in the United States are 30 to 35 years old. There appears to be a considerable amount of radioactivity along the Rocky Mountains and the Andes ranges of the Southern Hemisphere. The strong radioactive waters in Central Europe, including Saxony and part of Czechoslovakia, are in close association with the sources of radium in Joachimstahl. The information on the Russian mineral waters has been received since the war and includes data on some springs in the Caucasus. The information on Asia and Africa is very sketchy. The hot mineral waters of New Zealand and the areas throughout the Pacific Islands would probably show some radioactivity if they were checked.

2784

A METHOD FOR THE DETERMINATION OF THE EARTH'S AGE. C. Festa and M. Santangelo. Ann. Geofisica 3, 251-61(1950) Apr. (In Italian)

With the aid of certain hypotheses on the process of disintegration of radioactive potassium under geological con-

ditions, a method is obtained for the determination of the earth's age. Using various analytical data concerning terrestrial and meteoritic material, the value 3.16×10^9 yr (±19%) is found. (auth)

METALS AND METALLURGY

2785

Sylvania Electric Products, Inc.
EQUILIBRIA IN THE DISSOCIATION OF BERYLLIUM IODIDE. Bernard Kopelman and Harry Bender. [nd.] 17p. (AECU-1028)

A study has been made of the decomposition of beryllium iodide as a function of temperature under apparent equilibrium to determine the equilibria involved. Preparation of beryllium iodide is described, and experiments in the presence of excess beryllium are detailed. From results obtained it is concluded that deposition of Be by the iodide process occurs solely by upsetting of equilibrium in the reaction $BeI_2(v) \rightleftharpoons Be + I_2(v)$ even though equilibrium in this system is reached when but 0.0006% Be and I_2 are obtained.

2786

Los Alamos Scientific Lab.
THE HEAT OF COMBUSTION OF MAGNESIUM AND ALUMINUM. Charles E. Holley, Jr., and Elmer J. Huber, Jr. [nd.] 10p. (AECU-1172; LADC-949)

Precise measurements of the heats of combustion of Mg and Al have been made. The apparatus used, an O_2 bomb calorimeter of rather standard design, is briefly described. For precise work it was necessary to correct for the electrical energy used in firing the charge and to determine the completeness of the combustion. The latter was done by treating the combustion products with acid and measuring the H_2 evolved. The results are as follows: for Mg, heat of combustion in 25 atm O_2 = 5896.0 ± 3.6 cal/g; heat of formation of MgO, $\Delta H_{298°K} = -143.73 \pm 0.09$ kcal/mole; for Al, heat of combustion in 25 atm O_2 = 7405.6 ± 5.2 cal/g; heat of formation of Al_2O_3, $\Delta H_{298°K} = -400.41 \pm 0.28$ kcal/mole. A comparison of these results with those of other investigators is made. (auth)

2787

Dow Chemical Co.
PREPARATION OF HIGH PURITY MAGNESIUM AND A STUDY OF THE EFFECT OF NON-METALLIC AND ALKALI METAL IMPURITIES ON THE CORROSION CHARACTERISTICS OF PURE MAGNESIUM; ANNUAL REPORT; DECEMBER 1, 1949–NOVEMBER 31, 1950. [nd.] 56p. (COO-21)

Sublimation and sublimation combined with settling procedures have been investigated as a means of producing high-purity Mg. Spectrographic, chemical, microchemical, x-ray-diffraction, electron-diffraction, and neutron-activation analyses have been utilized to evaluate the impurities in the materials under study. Electron micrographic studies and autoradiographic techniques have also been employed. Various corrosion techniques have been investigated. Mg spectrographically free of all impurities with the exception of Na and Ca has been produced. In certain cases the latter elements have each been reduced to <5 ppm. Investigations to date indicate that P (0 to 4500 ppm), free C (0 to 77 ppm), and nitrides (0 to 2600 ppm) have a negligible effect on the corrosion rate of high-purity Mg. In contrast, however, chlorides when introduced as flux show a tolerance limit at about 70 ppm. Commercially pure Mg billet currently runs 5 to 10 ppm of Cl. High-purity Mg as produced by the process of multiple sublimation showed no decrease in corrosion rate in 3% NaCl subsequent to the second sublimation. Mg has been found to be subject to crevice corrosion, which implies that the metal must be free of physical defects if good corrosion rates are to be obtained. A sublimation vacuum-casting unit has been built and successfully operated. This equipment can be operated so as to sublime Mg at 0.0005 mm Hg and condense, melt, and cast 100 lb of pure Mg into a billet without exposing the metal to air.

2788

Department of Engineering, Univ. of California
RESEARCH CREEP OF ALLOYS; TECHNICAL PROGRESS REPORT TO JANUARY 1, 1951. E. R. Parker and T. H. Hazlett. Jan. 1951. 6p. (COO-40)

Production and Metallurgical Control of Alloys. A lack of reproducibility and inconsistency of test results obtained with high-purity Ni specimens caused a re-examination of the entire melting, refining, and heat-treating procedure. The principal difficulty was traced to small differences in the composition of the Mg master alloy, which is added to tie up the free sulfur. Small differences in the amount of reduction during forging and in the forging temperature also caused differences in the properties of the final specimens. These inconsistencies were minimized by increasing the number of steps used in swaging the bars to final size and introducing intermediate anneals between each stage. Considerable work has been expended on the preparation of solid solution alloys of Ti, W, and Zn, in Ni. Duplicate ingots of four different amounts of Ti and three different percentages of W have been made. A 50% Ni–50% Zn master alloy has been made successfully.

Creep Testing Program. Several series of tests have been completed on Ni alloys containing 1, 2, and 3 at. % Ti. It was found that the increase in creep resistance of Ni due to the addition of even 1 at. % was so large that alloys have subsequently been prepared containing 0.25 and 0.5 at. % alloying addition. A few tests to determine the effect of grain size on the creep rate of pure Ni show that specimens with ~5 grains/mm² have a much faster creep rate and fail at a smaller total strain than finer grained specimens of ~50 grains/mm².

Studies to Determine State of Material. Brief statements of progress on measurement of thermal electromotive force, change in electrical resistivity with deformation, and x-ray-diffraction line broadening are presented.

Lattice Parameter Determinations. Precision lattice parameters corresponding to a temperature of 725°C were measured for the 1, 2, and 3 at. % Ti alloys. It was found that a graph of a_0 values versus atomic per cent Ti exhibits the straight-line relation of Vegard's law.

2789

[Carnegie Inst. of Tech.]
PROGRESS REPORT FOR OCTOBER, NOVEMBER, DECEMBER, 1950. R. Smoluchowski, L. Couling, R. Flanagan, S. Hayes, C. W. Haynes, B. Sawyer, and R. Turner. Dec. 1950. 3p. (NYO-519)

Further work on grain-boundary diffusion of Zn in Cu and of radioactive Ag in Cu is reported. A new Cu bi-crystal has recently been grown with parallel (100) poles and (010) poles 20 deg apart. Experiments to produce columnar crystals of Fe by the decarburization of mild steel at about 780°C showed that a generally columnar structure resulted, but the grain size was too small to be used. Attempts to grow columnar crystals with a directed relative orientation have failed. The small-angle scattering camera is being applied to known standards for comparison. It has been observed that the rate of heating affects the relative abundance of the three types of preferred orientation in recrystallized Fe–Co alloy.

2790

Stanford Univ.
INVESTIGATION OF MATERIALS FOR USE IN HEAT TRANSFER SYSTEM CONTAINING MOLTEN LEAD ALLOYS; REPORT NO. X; NOVEMBER 1, 1950, TO JANUARY 31, 1951. O. Cutler Shepard and Ralph Parkman. Feb. 5, 1951. 17p. (ORO-24)

Short-time unstressed corrosion tests show that Mo, W, and Ta have good resistance to molten Pb and Bi at 1800°F. Nb shows good resistance to molten Pb but is heavily attacked by Bi at 1800°F. Type 446 stainless steel shows limited resistance for short times to Fb at 1800°F and is heavily attacked by Bi. Ti and Zr have poor resistance to attack by both Pb and Bi. Stress-rupture curves of Ta and Mo in molten Pb and Bi at 1500°F are very similar and indicate a good degree of stress-corrosion resistance. Type 446 stainless steel shows poor strength and unsatisfactory long-time corrosion resistance at 1500°F. A precipitate, presumably a solid solution of Fe and Cr, has been noted in both the Pb and Bi baths after long-term stress-rupture tests. Indications are that this material was dissolved from the type 446 stainless steel stress-rupture frame and reprecipitated in a cooler zone of the liquid bath. The degree of molten Bi attack on Fe-Cr alloys at 1500°F appears to increase in proportion to the Cr content of the alloy. Preliminary solubility measurements at 1500°F indicate a solubility of Mo in pure Pb on the order of 3×10^{-4} %. (auth)

2791

Sylvania Electric Products, Inc.
SELF-DIFFUSION OF METALS AND ASSOCIATED PHENOMENA (IV). B. H. Alexander, R. W. Balluffi, M. H. Dawson, C. A. Dube, H. P. Kling, and F. D. Rosi. Dec. 28, 1950. 66p. (SEP-43)

Diffusion Studies. The study of chemical diffusion in the α phase of the Ag–Sn system was completed, and an evaluation of the diffusion rates was made. The vacuum dezincification technique was used for investigating the development of porosity in α brass during diffusion and the mobilities of Cu and Zn during diffusion. The formation of pores in a Cu–Ni solid solution alloy was also studied. Multiple-diffusion specimens were prepared to study the vacancy hypothesis of pore formation. An investigation was started of the change of pore size and configuration with temperature in Cu wires wound on a spool. Measurements of density gradients in Ag compacts were continued along with a study of the effect of sintering atmosphere on grain size. Further work was done on porous-solid diffusion couples and on the self-diffusion of Al.

Recrystallization and Grain Growth. An investigation was started on the nature of the deformation process in its relation to recrystallization as a function of the degree of shear hardening in high-purity single crystals of Ag. In the studies of secondary recrystallization, rate measurements were made of OFHC Cu, and plans were made to start work on Al and Mg. Preliminary observations were also made of secondary recrystallization of Mg–Al alloys in the form of cold-drawn rods. Measurements were started on Cu–Fe couples to determine the grain-boundary energies of ferrite-austenite, cementite-austenite, and cementite-ferrite interfaces.

Creep and Plastic Flow. Initial data were taken on constant-stress creep of pure Ag. The plastic behavior of single crystals of Ag was studied at 295 and 205°K for small amounts of extension. In the investigation of the effects of grain boundaries on plastic flow, the work on Pb and on pure Al is continuing. 31 figures. (auth)

2792

General Electric Research Lab.
LATTICE AND GRAIN-BOUNDARY SELF-DIFFUSION IN SILVER. R. E. Hoffman and D. Turnbull. Nov. 1950. 21p. (SO-2011; RL-460)

Through the use of a radioactive plating technique the lattice and grain-boundary self-diffusion coefficients of high-purity silver have been measured over extended temperature ranges. It has been found that the lattice diffusion coefficients are described by the equation $D_L = 0.895 \exp(-49500/RT)$ cm²/sec and are independent of the thermal history of the crystals within wide limits. The absolute grain-boundary diffusion coefficients fit the equation $D_B = 0.03 \exp(-20200/RT)$ cm²/sec and are independent of the grain size of the specimens. (auth)

2793

ACTION OF HOT IONIZED GASES UPON ZIRCONIUM AND COPPER. Andrew Dravnieks. J. Phys. & Colloid Chem. 55, 540-9(1951) Apr.

By measuring changes in electrical resistance the relative reaction rates of Zr at 986°C with low-pressure ionized and nonionized O_2, air, water vapor, CO_2, CO, N_2 containing 0.5% O_2, ethane, and technical He were studied. In some cases an acceleration and in others a retardation of the reaction upon ionizing the gas was observed. The retardation may be explained by a cleanup effect on the surface of the metal or reaction film by the nonreacting components of the gas phase. The oxidation in water vapor was abnormally fast as compared with the oxidation in oxides of carbon or in N_2 with 0.5% O_2. The oxidation of Cu in both forms of gases was studied at 750°C. The ionization of CO_2 caused a slow oxidation of Cu, which proceeded according to the parabolic

law. Cu did not undergo oxidation in ionized or nonionized CO. A method of recording continuously the progress of the oxidation of metal strips is described. 31 references. (auth)

2794

AMORPHOUS GERMANIUM. H. Richter and O. Fürst. Z. Naturforsch. 6a, 38-46(1951) Jan. (In German)

Whereas thick layers of Ge, obtained by evaporation in vacuum, are crystalline, thin coatings are amorphous. Since it is difficult to submit thin films to x-ray investigation, a method of successively piling up thin layers, by transporting them on a collodion membrane from the support upon which they had been formed, was devised. The atomic distribution in amorphous Ge is quite different from that observed in the liquid state. Some orientations resemble the crystalline lattice. A hypothetical model explains these relations.

2795

Naval Engineering Experiment Station, Annapolis
CORROSION AND MECHANICAL PROPERTIES OF TITANIUM AND ZIRCONIUM AT NORMAL TEMPERATURES. W. Lee Williams. [nd.] 47p. (EES-C-3395-B, C-3501-C)

The data contained herein expand on the work presented previously in Report C-3395: C-3501-B dated 9 February 1950. The Ti and Zr materials investigated represent metal consolidated by powder metallurgy and by several melting processes. These in turn reflect various impurity levels, especially of the C. The chemical compositions and tensile properties are reported. Corrosion tests are included for long exposure periods in a marine atmosphere and in quiet sea water (fouling conditions). Other corrosion tests include those in slowly moving sea water for Ti with and without coupling to various other metals. Data are presented concerning the resistance of Ti to hydraulic cavitation resistance. The very high order of resistence to marine corrosion continues to be particularly attractive. Further fatigue tests are reported on notched and unnotched specimens. Good fatigue properties, with high endurance ratios, continue to be found with the melted product. Of particular interest is the discovery that the resistance to salt-water corrosion fatigue is very nearly equal to the fatigue strength in air; the salt-water corrosion-fatigue properties seem to be superior to those for any other known structural alloy. The tests of the 2½% Cr−1% Fe alloy demonstrate the superior properties to be realized by Ti alloys. In the annealed condition, properties of this particular alloy were as follows: tensile strength, 132,000 psi; yield strength, 116,000 psi; endurance limit, 71,000 psi; elongation, 22%; and reduction of area, 51%. (auth)

2796

EQUILIBRIUM AND RATE OF ALUMINUM MONOCHLORIDE FORMATION FROM ALUMINUM CHLORIDE AND ALUMINUM. Allen S. Russell, Kenneth E. Martin, and C. Norman Cochran. J. Am. Chem. Soc. 73, 1466-9(1951) Apr.

Al halides cause Al to volatilize at temperatures where its vapor pressure is negligible and to redeposit as metal when cooled. AlCl has been proved spectroscopically to be involved in the chloride distillation. AlCl formation from $AlCl_3$ and Al has been measured by determining the amount of Al transported by $AlCl_3$ in an alumina-lined quartz vessel. The equilibrium corresponded to 13.4% reaction at 1115°C and 74 cm pressure. From the derived heat of AlCl formation at 0°K, −10.7 kcal, and other thermodynamic data, the equilibrium curves for monochloride formation have been drawn for a range of temperatures and pressures. Under the test conditions employed, the reaction rate was largely controlled by the diffusion of $AlCl_3$ to the Al surface against the stream of monochloride diffusing away from it.

2797

TEN ZIRCONIUM ALLOYS EVALUATED. F. B. Litton. Iron Age 167, 112-14(1951) Apr. 12

A number of Zr alloys were heated in still air at 750°C to determine their oxidation resistance relative to Zr. The results of an initial survey are recorded. Data were obtained on both induction- and arc-melted alloys. The oxidation resistance of Zr was not improved by alloying. Minor amounts of Al and N_2 decreased, whereas O_2 slightly increased oxidation resistance. Arc-melted metal was found to have better resistance to oxidation than induction- or graphite-crucible-melted Zr.

2798

TITANIUM-BORON ALLOYS. H. R. Ogden and R. I. Jaffee. J. Metals (N.Y.) 3, 335-6(1951) Apr. (Technical note; see also NSA 5-401)

Iodide-type Ti and high-purity crystalline B have been used in an investigation of the solubility of B in Ti. Metallographically, it was found that a second phase was present in alloys containing as little as 0.4% B, and that the quantity of the second phase increased with increasing B content. It was concluded from the data obtained that the solubility of B in both α and β Ti is probably very low and that B has no observable effect on the transition temperature of Ti.

2799

VAPOR PRESSURE OF INORGANIC SUBSTANCES. IV. TANTALUM BETWEEN 2624 AND 2943°K. James W. Edwards, Herrick L. Johnston, and Paul E. Blackburn. J. Am. Chem. Soc. 73, 172-4(1951) Jan.

The vapor pressure of Ta was determined over the temperature range 2624 to 2948°K by measuring the rate at which a metal surface evaporates in vacuum. Values of ΔH_0° were calculated from the individual vapor pressures and showed no appreciable trend, the average value being 185.5 ± 0.3 kcal. By combining this value with free-energy functions for solid and gaseous Ta, the following vapor-pressure equation was obtained: $R \ln p = -185.5 \times 10^3/T + 3.7 \times 10^{-4} T - 8.4 \times 10^{-8} T^2 + 32.87$, where p is pressure in atmospheres. The experimental results agree accurately with the earlier work of Langmuir and Malter (Phys. Rev. 55, 743(1939)), but disagree with those of Fiske (ibid. 61, 513(1942)). (auth)

2800

THE VAPOR PRESSURE OF INORGANIC SUBSTANCES. V. ZIRCONIUM BETWEEN 1949 AND 2054°K. Gordon B. Skinner, James W. Edwards, and Herrick L. Johnston. J. Am. Chem. Soc. 73, 174-6(1951) Jan.

The vapor pressure of Zr has been determined in the temperature range 1949 to 2054°K by measuring the rate at

which a Zr surface evaporates into a vacuum. Values of ΔH_0° have been calculated from the individual vapor pressures and show no appreciable trend, the average value being 142,150 ± 350 cal/mole. By combining this value with free-energy functions of gaseous Zr and with extrapolated values for the solid, the following equation for vapor pressure is obtained: $\log P(atm) = -31{,}066/T + 7.3351 - 2.415 \times 10^{-4}T$. (auth)

2801

VARIATION OF THE MICROHARDNESS OF MONOCRYSTALS AS A FUNCTION OF THE ORIENTATION OF A PYRAMIDAL PENETRATOR. Henri Roth-Meyer. Compt. rend. 231, 906-8(1950) Oct. 30. (In French)

A systematic study of the shapes, slip lines, and variation of diagonal length with orientation on the various crystal faces of the impression in pure Al (cubic) and Zn (hexagonal) produced by the pyramidal point of a Vickers hardness tester has been carried out. It is concluded that a pyramidal penetrator permits greater discrimination in deciphering the variations in hardness due to anisotropy and in determining the orientation of the crystal faces than does a spherical or conical point. 6 figures.

2802

VISCOSITY OF THE SODIUM–POTASSIUM SYSTEM. Curtis T. Ewing, Joseph A. Grand, and R. R. Miller. J. Am. Chem. Soc. 73, 1168-71(1951) Mar.

A closed viscometer technique was developed and applied to reactive metals with unusually high surface-tension ranges. Viscosities were measured for Na, K, and several alloys from 60°C (or the m.p.) to 200°C. The values for the alloys were observed to vary uniformly between those for the metals, and a mixture equation was applied to satisfy the data. It was also shown that the temperature variation of the viscosity values could be adequately expressed by the equation set forth by Andrade. (auth)

MINERALS AND MINERALOGY

2803

Carbide and Carbon Chemicals Corp., Y-12 Area
PROGRESS REPORT ON CARNOTITE STUDIES; CARBONATE PROCESS; SEPTEMBER 1949. K. B. Brown and C. F. Coleman. Oct. 6, 1949. Decl. March 5, 1951. 23p. (AECD-3076; Y-498)

Work on the Carbonate (Monticello) Process. Projects continued during the current month are (1) the determination of maximum U build-up during carbonate leaching of raw and salt-roasted ore, (2) the measurement of the carbonate consumption during leaching, and (3) the study of the feasibility of recycling plant waste liquors to the leach circuit. In addition, a brief investigation was made of a process in which the raw ore is leached with Na_2CO_3, the sands and slimes are separated, the sands are leached with acid, and the slimes are roasted in a pellitized form. The Recovery of Uranium and Vanadium from Carbonate Liquors. Yellow-cake precipitation tests with larger volumes of leach liquor from raw ore gave results similar to those previously reported. Attempts to precipitate V completely with yellow cake were successful only with a liquor derived from an Indian Reservation ore. With liquor derived from a Monticello stockpile ore, V precipitation was not complete, and redissolution of U was excessive. The better results with the Indian Reservation liquor were probably due to the purity and the higher concentration of that liquor, which was dissimilar to any other raw leach obtained. Recovery of V as ferrous vanadate from these solutions has been successful under a fairly wide range of conditions.

2804

Utah Univ.
THEORY OF COLLECTOR—DEPRESSANT EQUILIBRIA AT MINERAL SURFACES. George A. Last and Melvin A. Cook. Oct. 15, 1950. 22p. (AECU-1118)

A comprehensive study of the equilibria involved in the system potassium N-amyl xanthate–$Na_2S.9H_2O$–galena was made. The "bubble pickup" method employed for this investigation was found to be sufficiently accurate to give consistently reliable experimental results. A theory for collector-depressant-mineral equilibria, based on single-site adsorption of the collector- and depressant-free acids, has been presented. The excellent agreement between theory and experimental results appears to establish the validity of this proposed mechanism. Re-evaluation of data available in the literature has led to further substantiation of the proposed theory for collector-depressant-mineral equilibria and has allowed the authors to present data indicating the magnitudes of the adsorption potentials for collector-mineral and depressant-mineral attachment. It is shown that the adsorption potentials for collectors and depressants are independent of the nature and concentration of the other species (depressant or collector) present in the system. This is in accord with the proposed mechanism of collector-depressant-mineral equilibria. (auth)

2805

A CONTRIBUTION TO THE CONTROVERSY ON THE GEOLOGIC AGE OF THE HAUGESUND PENINSULA FORMATIONS. Ivan Th. Rosenqvist. In Forsvarets Forskningsinstitutt, Årbok 1947, 39-40. (In Norwegian)

The author visited the uranium-bearing locality on the Haugesund Peninsula, Norway, and analyzed a concentrate from the original, very micaceous ore. The main constituents of the concentrate were 81.35% U_3O_8, 0.31% ThO_2, 4.72% rare earths, and 5.78% PbO. The micaceous ore forms a 20- to 40-cm-wide border on one side of a pegmatitic mass intruding an amphibolitic gneiss. The pre-Caledonian age of the latter having been questioned lately, the author, using the ratio Pb^{206}/Pb^{207} in the ore concentrate, determined the age of the pegmatite intrusion as 300×10^6 yr, i.e., as belonging to the Caledonian revolution. Although throwing some new light on the local geologic chronology, this information still leaves open the main question on the age of the enclosing gneiss.

2806

DIFFUSION COEFFICIENT OF LEAD IN SOME RADIOACTIVE MINERALS. Ivan Th. Rosenqvist. In Forsvarets Forskningsinstitutt, Årbok II, 1948-49, 307-29. (In Norwegian)

The following average diffusion coefficients of lead in some radioactive minerals, since the formation of the minerals, have been calculated: 4×10^{-19} cm²/sec in samarskites-yttrotantalites, 1×10^{-18} cm²/sec in uranothorites, and $(2 \text{ to } 4) \times 10^{-22}$ cm²/sec in uraninites. Some geological conclusions are drawn. (auth)

2807

THE URANIUM MINERALS FROM THE HILLSIDE MINE, YAVAPAI COUNTY, ARIZONA. Joseph M. Axelrod, Frank S. Grimaldi, Charles Milton, and K. J. Murata. Am. Mineral. 36, 1-22(1951) Jan.-Feb.

A small deposit, coating gypsum on the 300-ft level of the Hillside Mine, Yavapai County, Arizona, was found to contain several hitherto unknown uranium minerals, together with schroeckingerite, which had been previously known only from Wyoming and Czechoslovakia. The new species are named andersonite, swartzite, and bayleyite; they are, respectively, hydrous uranyl carbonates of Na and Ca, of Ca and Mg, and of Mg, all of general formula $X_4UO_2(CO_3)_3 \cdot nH_2O$, where X_4 represents Na_2Ca, $CaMg$, and Mg_2, and n = 6, 12, and 18, respectively. With these minerals occur two other new substances, naturally occurring dehydration products of swartzite and bayleyite whose definitive properties are not well enough known to permit proposal of them as valid species. Andersonite, swartzite, and bayleyite, previously unknown either as minerals or synthetic compounds, have been synthesized. Analyses, optical data, x-ray patterns, and crystallographic data of these new species and x-ray patterns of the two dehydration products are given. Schroeckingerite also has been analyzed, and its formula has been found to differ from that given in the older accounts in the literature; the analysis agrees closely with that of the Wyoming schroeckingerite recently reported by Jaffe et al. (Am. Mineral. 33, 152-7(1948)). The various uranium carbonate minerals recorded in the literature are considered briefly. Of them, liebigite (= uranothallite) and schroeckingerite are well established. Voglite is almost certainly valid, but randite certainly, and rutherfordine probably, are to be discredited; sharpite may be valid; the status of studtite and diderichite is very doubtful. 23 references. (auth)

2808

URANIUM MINING IN CANADA. W. J. Bennett. Precambrian 24, 13-15, 17, 41(1951) Apr.

A general summary is presented of the problems encountered in obtaining U. A discussion is made of the policies of the Atomic Energy Control Board of Canada and the USAEC with respect to the control of radioactive materials and prices paid for ores. Technical problems are presented with regard to the location of the ore, operating costs, methods of recovery, and rarity of deposits.

PHYSICS

2809

Columbia Univ.
PROGRESS REPORT; NUCLEAR PHYSICS LABORATORIES. J. R. Dunning, Director. Sept. 30, 1950. 30p. (CUD-61; DR-1566)

Separate abstracts have been prepared on the following sections of this report: Neutron Velocity Spectrometer Transmission Measurements, sect. I; Neutron Scattering Experiments, sect. II; Analytical Laboratory and Crystal Growing, sect. III; Radiochemical Laboratories, sect. IV; Instrument Development, sect. V; Light Particle Investigations, sect. VI.

2810

Oak Ridge National Lab.
QUARTERLY PROGRESS REPORT FOR PERIOD ENDING SEPTEMBER 20, 1950; PHYSICS DIVISION. A. H. Snell, Director. Jan. 8, 1951. 107p. (ORNL-865)

Separate abstracts have been prepared on the following: Radioactivity Studies, p.12-31; Neutron Physics and Low Temperatures, p.32-48; Neutron Diffraction, p.49-55; High Voltage Accelerator Program, p.56-61; Search for a Permanent Electric Dipole Moment of the Neutron, p.62; Thermal Neturon Diffusion in Water, p.63; Theoretical Physics, p.64-76; Phase Transition on Neutron Bombardment, p.77; X-ray Diffraction and Crystal Structure, p.78-84; Heavy Positive Ion Bombardment Studies, p.84-86; Semiconductor Bombardment Research, p.87-95; Physics of Solids New Hot Laboratory, p.95-7; Bonded Wire Resistance Strain Gages, p.98-106; and Effect of Pile Radiation on Performance of Electrical Leads, p.106-107.

2811

ATOMIC PHYSICS. Wolfgang Finkelnburg. New York, McGraw-Hill Book Company, Inc., 1950. 498p. (See also NSA 4-2425)

This book is a translation of the German "Einfuhrung in die Atomphysik" and is equivalent to the forthcoming revised second German edition. Subject matter includes material on atomic spectra and structure, atomic theory according to quantum mechanics, nuclear physics, molecular physics, and atomic physics in the liquid and solid state. An extensive review by R. B. Bowersox has appeared in Am. J. Phys. 19, 134-5(1951) Feb.

2812

BORIDE CATHODES. J. M. Lafferty. J. Applied Phys. 22, 299-309(1951) Mar.

The thermionic emission properties of the borides of the alkaline-earth and rare-earth metals and Th have been investigated. These compounds all have the same formula MB_6 and the same crystal structure consisting of a three-dimensional B framework in whose interlattice spaces the metal atoms are embedded. The valence electrons of the

metal atoms are not accepted by the B_6 complex, thus giving rise to the presence of free electrons which impart a metallic character to these compounds. This, together with the strong bonds between the B atoms in the framework, produces a series of compounds which have high electrical conductivities and high thermal and chemical stabilities—ideal properties for a cathode material. When this structure is heated to a sufficiently high temperature, the metal atoms at the surface evaporate away. They are, however, immediately replaced by diffusion of metal atoms from the underlying cells. The B framework does not evaporate but remains intact. This process gives a mechanism for constantly maintaining an active cathode surface. Thermionic emission measurements made on these materials show the rare-earth metal borides to be superior to the others. The highest emission was obtained from La boride. Its emission constants for the Dushman equation were $\phi = 2.66$ volts and $A = 29$ amp/cm^2/°K^2. (auth)

2813

FIRST PRINCIPLES OF ATOMIC PHYSICS. R. E. Humphreys and R. Beringer. New York, Harper and Brothers, 1950. 390p.

This book is divided into three definite parts, the first dealing with elementary mechanics and heat. In the second part the principles of electricity and magnetism are presented. The third and main part of the text is devoted to atomic and nuclear phenomena. An extensive review by R. L. Edwards has appeared in Am. J. Phys. 19, 67(1951) Jan.

2814

INTRODUCTORY NUCLEAR PHYSICS. David Halliday. New York, John Wiley & Sons, Inc. 1950. 558p.

After a very brief historical introduction at the beginning of the first chapter, the author devotes several paragraphs to a discussion of "operational philosophy," in which the validity of a theory is determined by the number of experiments which it can describe in a simple and accurate manner. This viewpoint is widely accepted in modern scientific thought and is particularly important in nuclear physics. The remainder of the first chapter deals with basic nuclear concepts, including discussions of the size and mass of the nucleus, the equivalence of mass and energy, and the properties of nuclear particles. The next four chapters deal with charged particles and photons. Their production, detection, and interaction with matter are discussed in considerable detail. The chapter following these is devoted to a discussion of neutrons and methods for their detection. Among the topics treated in the remainder of the book are nuclear masses, relative mass abundances, nuclear forces, nuclear reactions, nuclear fission, and cosmic rays. There is also a chapter on particle accelerators, which includes descriptions of the electrostatic generator, linear accelerator, cyclotron, synchrocylotron, betatron, synchrotron, and the bevatron. The book also contains two appendixes containing a list of physical constants and a short résumé of recent developments in nuclear physics which occurred too late to be included in the body of the book. The preceding statements are taken from a review by Marshall D. Earle. J. Franklin Inst. 251, 302(1951) Feb.

2815

Office of Naval Research, London
RADIOCHEMISTRY RESEARCH AT THE ROYAL INSTITUTE OF TECHNOLOGY, STOCKHOLM. George J. Szasz. Sept. 28, 1950. 4p. (ONRL-103-50)

Current research activities in the Department of Theoretical Chemistry under the direction of Prof. Ole Lamm at the Royal Institute of Technology, Stockholm, Sweden, are briefly described. These include, among others, work on the absorption of β rays in matter, the adoption of radioactive techniques to surface chemistry, and the conduction of heat in pure solids and in solid solutions. (auth)

2816

STATISTICAL MECHANICS OF LIQUID MIXTURES OF He^3 and He^4. J. De Boer and C. J. Gorter. Physica 16, 667-8(1950) July-Aug. (Erratum)

Errors involving Figs. 1 and 3 of this article, which was abstracted in Nuclear Science Abstracts as NSA 4-4906, are corrected and Fig. 4 is replaced by a simpler representation.

ASTROPHYSICS

2817

REMARKS ON WEIZSACKER'S THEORY OF THE EVOLUTION OF GIANT STARS. Hans-Jost Binge. Z. Naturforsch. 6a, 49-53(1951) Jan. (In German)

According to von Weizsäcker's criteria of star ages (Z. Astrophys. 24, 204(1947)), red giants, long accepted as the youngest members of the main sequence, should be considered among the oldest cosmic objects, originated from small stars of sufficient mass which had abandoned the main sequence and developed huge atmospheres with the aid of energy freed during a contraction. After a rough estimation of the energy liberated during the transition of a star, after having used up its hydrogen, into the state of a neutron drop, the lifetime of such red giants is calculated. An analysis of existing data on open clusters and double stars confirms the great age of the red giants.

COSMIC RADIATION

2818

THE EMISSION OF Li^8 FROM COSMIC RAY INDUCED NUCLEAR DISINTEGRATIONS. P. E. Hodgson. Phil. Mag. (7) 42, 207-12(1951) Feb.

Li^8 nuclei ejected from cosmic-ray-induced disintegrations have been investigated using the photographic plate method. Earlier work has been confirmed, and the frequency and energy distribution of the Li^8 nuclei have been determined and compared with the predictions of the evaporation theory. Some nuclear reactions involving the production of Li^8 have been identified. (auth)

2819

EVIDENCE FOR THE ENTRY INTO THE UPPER ATMOSPHERE OF HIGH-SPEED PROTONS DURING AURORAL

ACTIVITY. A. B. Meinel. Science 112, 590(1950) Nov. (Technical Papers)

The article is reproduced here in its entirety.

During the intense auroral activity on the nights of August 18-19 and 19-20, 1950, several spectra were taken with the spectrograph designed by the writer (Pubs. Astron. Soc. Pacific, 60, 257(1948); Astrophys. J., 111, 555(1950)). It would take some time to analyze all the information contained in these spectra, but one result of the observation seems worth recording at once. A spectrum of an auroral arc in the magnetic zenith taken on August 19-20 showed that the H-alpha emission line is strongly asymmetric to the violet. On this occasion the spectrograph was pointed parallel to the magnetic lines of force so that any incident auroral particles would be approaching the spectrograph. The profile of H-alpha is found to be asymmetrical, with a maximum violet displacement of 60 A, corresponding to a velocity of 2800 km/sec. The H-alpha line viewed perpendicularly to the magnetic lines is, however, symmetrical and undisplaced, but it is broadened by approximately 6 A. The red edge of the asymmetrical H-alpha emission has a profile showing a similar spread of 6 A. Broadened hydrogen lines have been observed before by Gartlein (Trans. Am. Geophys. Union 31, 19(1950)). These earlier observations, however, were made with the spectrograph pointed normal to the magnetic lines. Consequently, no Doppler displacements of the kind noted here have been observed before. These observations therefore establish for the first time that protons of probably solar origin are streaming into the upper atmosphere at velocities of the order of 2500 to 3000 km/sec.

2820

NOTE ON SOFT GAMMA-COMPONENT OF COSMIC RAYS. F. G. Rest, L. Reiffel, and C. A. Stone. Phys. Rev. 81, 894(1951) Mar. 1. (Letter to the editor)

A short note is presented on the study of the soft γ component of cosmic rays at 30,000 ft, using a close-packed G-M counter arrangement so as to minimize the effects of dead space between tubes and the intrinsic inefficiency of the tubes for ionizing particles. The omnidirectional flux of soft γ radiation was measured as 3.4 photons/cm^3/sec and of ionizing radiation as 0.45 particles/cm^2/sec.

2821

ON THE ORIGIN OF ROSSI SHOWERS BENEATH DENSE, THICK SCREENS. André Fréon and Tsai-Chu. Compt. rend. 231, 850-1(1950) Oct. 23. (In French)

The barometric coefficients at sea level of Rossi showers beneath 18 cm of Pb, and beneath 2 cm in the region of the cascade maximum, have been measured to be -6.25 ± 0.7 and $-2.6 \pm 1\%$/cm Hg, respectively. The latter value is close to the barometric coefficient of mesons, whereas the value obtained beneath 18 cm of Pb is intermediate between that of mesons and the nuclear component. A measurement at 2900-m altitude at the Pic du Midi observatory under 10 cm of Pb showed an increase over the sea-level coincidence rate, which is greater than that of the total penetrating component. The nuclear component thus contributes 10 to 20% of the effect observed at sea level.

GASES

2822

Argonne National Lab.
SOLIDIFICATION OF He^3. D. W. Osborne, B. M. Abraham, and B. Weinstock. Jan. 3, 1951. Decl. Feb. 19, 1951. 6p. (AECD-3061; ANL-WMM-756)

He^3 has been solidified, and a portion of the melting curve has been determined by the blocked capillary technique. The melting pressure was found to change from 40.5 atm at 1.02°K to 56.6 atm at 1.51°K. A schematic diagram of the apparatus is shown. Since any reasonable extrapolation of the data gives a positive melting pressure at absolute zero, it appears likely that He^3, like He^4, does not have a triple point, and that the liquid is the stable condensed phase at absolute zero.

2823

Argonne National Lab.
POTENTIAL FIELDS AROUND IONS IN HIGH TEMPERATURE GAS MIXTURES. (abstract) Geoffrey Keller and R. E. Meyerott. Dec. 1, 1950. 1p. (AECU-1121; UAC-330)

The report is reproduced here in its entirety.

Preliminary to the calculations of the radiative opactiy of gas mixtures of astrophysical interest, a study has been made of the potential fields in the neighborhoods of gaseous ions, with particular emphasis on the effects due to adjacent ions. Methods used heretofore have assumed that each ion is enclosed in a spherical volume of radius a_z (Marshak et al., Astrophys. J. 111, 214(1950)) wherein no other ions are permitted. This is, of course, only a first approximation. Using a generalized Thomas-Fermi method, it has been found that, for pure iron at 11,600,000° and with three bound electrons, the density of neighboring ions at a distance of $\frac{1}{2}\, a_z$ from any particular ion is still appreciable. For a gas mixture of the proportions suggested by Harrison Brown (Revs. Modern Phys. 21, 625(1949), Table III), the densities of H, He, O, and Fe ions at $\frac{1}{2}\, a_z$ are 76, 57, 13, and 0% of the respective average densities. The accompanying depression of the ionization potentials is only 60% of that computed by Morse's method.

2824

BEHAVIOR OF VARIOUS GASES AND SEPARATION OF GAS MIXTURES IN A VORTEX TUBE. Karl Elser and Michael Hoch. Z. Naturforsch. 6a, 25-31(1951) Jan. (In German)

By the work of Hilsch (Z. Naturforsch. 1, 208(1946)) much attention has been drawn to the "vortex tube" proposed by Ranque (J. phys. radium (7) 4, 112(1933)), in which gas under pressure is introduced tangentially through a lateral orifice into a cylindrical tube open at both ends; the vortex formed shows a curious temperature effect (Ranque's effect; see Fulton, J. Am. Soc. Refrig. Engrs. 59, 473(1950)) — the gas near the tube's axis is colder, while that at the periphery is warmer, than originally. Although the efficiency of the process is too low to warrant applications in refrigeration techniques, enrichment of gas mixtures can be envisaged. Although it does not furnish a definite

explanation of the phenomenon, the author's experiments confirmed the idea of a preponderant part played by gas-kinetic processes. This view was supported by temperature measurements using various gases, by observations of similar effects in other cases of currents of fluids, and especially by the phenomenon of partial separation of gases in the vortex tube.

2825

ON THE PRESSURE DEPENDENCE OF THE THERMODIFFUSION COEFFICIENT. Rolf Haase. Z. physik. Chem. 196, 219-34(1950) Dec. (In German)

By thermodynamical methods a certain part of the thermodiffusion coefficient α of a binary mixture of real gases under a pressure P can be calculated. A theorem is derived relating this calculable part with the thermodiffusion coefficient α_0 for the ideal case $P \to 0$. The theorem permits a partial determination of α as a function of the pressure, the temperature, and the concentration, when α_0 is given as a function of both the temperature and the composition, and the constants of the equation of state are known. A comparison with experiments by Becker (Z. Naturforch. 5a, 457(1950)) shows the applicability of the theorem at high pressures (about 80 atm). (auth)

INSTRUMENTS

2826

California Inst. of Tech.
THE CIT ROTATING MIRROR CAMERA (MOD 2); PROJECT CAMEL. I. S. Bowen. Apr. 27, 1945. Decl. Nov. 27, 1950. 21p. (AECD-3028; K-3.1)

The theory of the rotating camera is explained and diagrammed. A description of the camera, including the motor assembly, camera body, film holder, and optical assembly, is given. Methods of adjustment are described. Photographs are included.

2827

Los Alamos Scientific Lab.
AIR TO GROUND TELEMETERING ANTENNA SYSTEMS. S. Stanley Locus. [nd.] 4p. (AECU-1009)

The advantages and disadvantages of various antennas and antenna systems to be mounted on airborne missiles being telemetered are presented. Longitudinal (trailing wire) and transverse (stub, fin, paste-on, crossed slot, and turnstile) antennas are discussed.

2828

Argonne National Lab.
CLEANING AND ALIGNMENT OF THE ELECTRON MICROSCOPE. Joseph G. Sayre. Sept. 1950. 19p. (ANL-4565)

The problem of maintaining consistent performance and high resolution from the electron microscope is primarily one of keeping the series of apertures, through which the electron beam must pass in image formation, free of all insulating particles and deposits, and also of preserving the high degree of symmetry of these apertures. One of the purposes of this discussion is to describe the cleaning materials and procedures that are used in the Argonne National Laboratory.

2829

Naval Research Lab.
CHARGE STORAGE IN CATHODE-RAY TUBES. C. V. Parker. Mar. 17, 1950. 22p. (NRL-3648)

The charging process in cathode-ray tubes used for static storage of information is analyzed both for a stationary spot and a linear scan, with and without redistribution of secondary electrons. Approximate equations are derived for the surface potentials and charging current as functions of time and other parameters, such as primary beam current, writing speed, and initial potentials. This is an interim report; work is continuing on the problem.

2830

Naval Radiological Defense Lab.
THE DESIGN AND FABRICATION OF A SPHERICAL REFLECTOMETER. Raydelle Josephson. Dec. 15, 1950. 13p. (AD-278(I))

A spherical reflectometer of 24 in. diameter, capable of measuring samples up to 4 in. in diameter, is described. The design permits reflectance measurements of various substances subjected to high-intensity radiation. (auth)

2831

RADIO TELEMETERING OF COINCIDENCES BETWEEN DISTANT COUNTERS. Étienne Picard, Anatole Rogozinski, and Maurice Surdin. Compt. rend. 232, 503-5(1951) Feb. 5. (In French)

Two types of transmitters-receptors used to register the coincidences between counters separated by several kilometers in the study of Auger showers are described. When line-of-sight transmission does not exist, a 5-Mc/sec 20-watt transmitter may be used. Because of government regulation of the band width, resolution of less than 5 μ sec is not possible. A 10,000-Mc/sec transmitter, powered by a klystron tube, permits a resolution time of less than 1 μ sec.

2832

TRANSMISSION LINE REFLECTION DOUBLING AMPLIFIER. John Marshall. Rev. Sci. Instruments 21, 1010-13(1950) Dec.

A pulse amplifier has been constructed using voltage doubling by reflection at the open end of a transmission line. Cathode followers are used to couple the output of one line into the input of the next. An amplifier using in each stage the four triode units of two 6J6's in parallel driving 16 ft of 100-ohm line has theoretically a voltage gain of 1.32 per stage. With appropriate grid-series compensation the gain can be made constant, theoretically, to 100 Mc. Experimentally the gain is 1.3 per stage with a rise time less than 6×10^{-9} sec. Below 50 volts, distortion is not serious for pulses shorter than twice the transmission time of the line. Pulses up to 150 volts can be handled by the amplifier. (auth)

2833

Bureau of Mines
UNIVERSAL TYPE ELECTROSTATIC SEPARATOR. Foster Fraas and Oliver C. Ralston. Feb. 1951. 6p. (BM-RI-4766)

Electrostatic separation depends on a number of electrical and mechanical properties such as conductance, contact potential, dielectric constant, and particle shape. In routine testing it is desirable that the application of each of these properties be investigated. The conductance property is best utilized in a separator having an ionic field, whereas the contact potential requires a separator with a pure static field. Dielectric constant and particle shape also influence the response in these two fields. There is no separator on the market that can be adjusted for all these requirements. The separator described in this paper is satisfactory for this purpose and is provided with a dielectric electrode, which permits formation of high-intensity static fields. (auth)

ISOTOPES

2834

New York Operations Office
USEFULNESS OF BROOKHAVEN REACTOR IN ISOTOPE PRODUCTION PROGRAM. Feb. 5, 1951. 10p. (NYO-866)

The advantages and disadvantages of Brookhaven isotope production with respect to geography, speed of delivery, quantities and specific activities produced, chemical separation facilities, and cost are compared with production at Oak Ridge and Chalk River.

2835

Oak Ridge National Lab., Y-12 Area
ELECTROMAGNETICALLY ENRICHED ISOTOPES (Inventory, February 28, 1951). C. P. Keim, C. E. Normand, and Boyd Weaver. Feb. 28, 1951. 62p. (Y-727)

The isotopes that have been concentrated electromagnetically are listed with the completed information on their enriched abundances, element weights, and product forms available in milligram quantities.

2836

THE ORIGINAL ABUNDANCE OF K^{40}. Camilla Festa. Ann. geofis. (Rome) 3, 489-99(1950) Oct. (In Italian)

The original abundance of potassium in the universe is calculated using certain rules relating abundances of elements with nuclear characteristics. By confronting the value so obtained with that determined on the basis of the decay constant of K^{40}, which is assumed to be equal to 1.97×10^{-9} yr^{-1}, it is found that the formation of the elements must have occurred about 3×10^{9} yr ago. It is concluded that, as a source of heat during and immediately after the formation of the earth's crust, the radioactivity of K played a much less important part than has been thought. (auth)

2837

PRODUCTION OF IODINE-132. W. E. Winsche, L. G. Stang, Jr., and W. D. Tucker. Nucleonics 8, 14-18(1951) Mar.

An announcement is made of the first availability of 2.4-hr I^{132}. A daughter of a fission product from the Brookhaven reactor, this medically important isotope is shipped in a receptacle, which is described, containing solid 77-hr Te^{132}, which decays to I^{132}.

2838

Division of Mathematical and Physical Sciences, NRC
RELATIVE ISOTOPIC ABUNDANCES OF THE ELEMENTS. K. T. Bainbridge and A. O. Nier. Dec. 1950. 59p. (NP-1971)

Available values of the relative isotopic abundances of the elements are listed. Adopted values presented by the authors are based on critical consideration of the nature of the original research, source of material used, purpose of investigation, etc. 280 references.

ISOTOPE SEPERATION

2839

APPARATUS FOR CONCENTRATION OF He^3 BY THERMAL DIFFUSION. O. F. Schuette, Jr., A. Zucker, and W. W. Watson. Rev. Sci. Instruments 21, 1016-18(1950) Dec.

A multistage thermal-diffusion apparatus for the concentration of He^3 is described. Included is a novel three-stage all-metal column based on a Calrod heater. Concentration was carried only to a He^3/He^4 ratio of 0.05%, a factor of 3.3×10^3. The performance indicates the importance of having the hot wall in concentric cylinder columns made of metal of good thermal conductivity to minimize azimuthal temperature gradients which can markedly increase parasitic remixing of the gas if a metal such as stainless steel is used. (auth)

MASS SPECTROGRAPHY

2840

ANALYSIS OF SOLIDS WITH THE MASS SPECTROMETER. J. G. Gorman, E. J. Jones, and J. A. Hipple. Anal. Chem. 23, 438-40(1951) Mar.

Although the mass spectrometer has been strikingly successful in recent years in the analysis of mixtures of gases and vapors, there has been no parallel success in the routine analysis of solids. This is because the most versatile source, the high-frequency spark, has been too erratic for the conventional mass-spectrometric method. A method whereby the spark source could be used in an instrument employing electrical recording is described. A method of compensating for fluctuations in the source is illustrated in the determination of the Ni and Cr content of six stainless steels. The results agree with the composition determined chemically. (auth)

2841

A DEMONSTRATION MASS SPECTROMETER. F. E. Christensen. Am. J. Phys. 19, 59-60(1951) Jan. (Note)

Note is made of a demonstration model, using steel and glass balls, of the conventional mass spectrometer. This model can be easily and economically constructed by fol-

lowing the detailed description presented of the original model. A schematic diagram of the apparatus is shown, labeled to indicate the functional correspondence between its parts and the parts of the research instrument.

2842

ELIMINATION OF THE EMISSION SLIT IN AN ION SOURCE. Francois Bertein. Compt. rend 231, 1134-6 (1950) Nov. 20. (In French)

The emission slit of the ion source of a Nier-type mass spectrograph, although usually regarded as the object, is really merely the location of an ionic image of the extraction slit produced by an interposed large slit acting as a lens and accelerator. If the image is smaller than the emission slit, the latter may be omitted or the opening may be increased in size. Necessary conditions for thus simplifying the ion source are considered.

MATHEMATICS

2843

Los Alamos Scientific Lab.
STATISTICAL ANALYSIS OF PULSE CHAINS BY MEANS OF ELECTRICAL NETWORKS. A. J. F. Siegert. Apr. 4, 1949. Decl. Sept. 6, 1949. 15p. (AECD-2972; LADC-670)

The conditional probability P(t)dt, defined as the probability that a pulse arrives in time interval (t,t + dt), where t > 0, if another pulse arrives at time zero, can be obtained by measuring the power spectrum of the current consisting in the pulse chain to be analyzed. The power spectrum of a chain of correlated pulses differs from that of a random chain by measurable amounts and yields directly the Fourier transform of P(t). (auth)

2844

Kenyon Coll.
EXTENSION OF MEASURE. (abstract) Otton M. Nikodým. [nd.] 2p. (AECU-1025)

Short note is made of a method of obtaining the same abstract Boolean lattice obtained by known measure-extension device.

2845

Kenyon Coll.
ON CONVEX SETS IN LINEAR SPACES. (abstract) William D. Berg and Otton M. Nikodým. [nd.] 2p. (AECU-1032)

Two paradoxical properties of convex bodies (convex sets possessing at least one interior point), are briefly noted. One is the possibility of linearly bounded convex bodies such that smallest convex set containing their union is not linearly bounded, and the second is the existence of a family of disjoint hyperplanes filling a real infinite dimensional linear space, each hyperplane of which meets a convex body in a nonempty set.

2846

Rochester Univ.
THE PRESENT STATUS OF VARIANCE COMPONENT ANALYSIS. S. Lee Crump. Jan. 25, 1951. 23p. (UR-155)

The general principles of variance component analysis are reviewed, with an indication of the types of problems in which the technique has been successful. Where, in a multiple classification, all the classes or subclasses of any chosen rank contain the same number of observations, the mean squares in the standard analysis of variance may be utilized for estimating variance components. This process is illustrated for a two-way classification.

MEASURING INSTRUMENTS AND TECHNIQUES

2847

Argonne National Lab.
COINCIDENCE INTERFERENCE IN THE PULSE ANALYZER. J. Mech and R. Keyes. June 29, 1950. 9p. (AECU-1141)

A method for calculating the counting rate of abnormally large pulses due to superposition of pulses in the pulse analyzer is described. This method is applied to the case of monoenergetic input pulses, and the result is compared to an experiment. An expression for the optimum counting rate for detection of high-energy pulses in this case is derived. (auth)

2848

Mound Lab.
A METHOD OF REBUILDING BORON-WALL NEUTRON-COUNTING TUBES. E. H. Daggett. Jan. 12, 1951. 7p. (MLM-530)

The most satisfactory procedure for repairing a Boron-Wall tube is to rebuild the tube completely. There are some modifications in the reconstruction of the boron-wall tube which are possible so that less expensive and more readily obtainable seals may be used. The end-caps are made of cold-rolled steel; the tension-spring suspension is different from the original; and a ⅛-in. Cu exhaust tube is used. The details are shown.

2849

Naval Radiological Defense Lab.
ALPHA SCINTILLATION PROBE COUNTER. R. H. Davis. Nov. 2, 1950. 17p. (AD-264(I))

An α scintillation counter has been developed to detect contamination in regions that are inaccessible to existing α detectors or which otherwise are ill-adapted to their use. The counter may be used for the direct detection of α activity in solutions, solid or liquid foods, or such human or animal body openings into which the counter probe can be introduced. Light from scintillations produced by α particles incident on the phosphor-coated tip of a quartz or glass rod is conducted by the rod to a photomultiplier tube. The counter may be used in a room illuminated by a 10-w red light provided that the direct rays from the light do not strike the phosphor-coated tip.

2850

BETA-RAY SPECTROSCOPES. E. Persico and C. Geoffrion. Rev. Sci. Instruments 21, 945-70(1950) Dec.

A review of the various types of β-ray spectrographs and spectrometers is presented. The principal theoretical re-

sults as to the resolving power and luminosity attainable under various conditions are briefly related. The construction and performance data of a number of instruments described in the literature are collected and compared by means of a graphical representation. 32 figures. (auth)

2851

COINCIDENCE MEASUREMENTS. Torleif Hvinden. In Forsvarets Forskningsinstitutt, Årbok II, 1948-49, 61-72. (In Norwegian)

A general discussion on circuits used in coincidence measurements is presented.

2852

A CONTINUOUSLY SENSITIVE CLOUD CHAMBER. T. S. Needels and C. E. Nielsen. Rev. Sci. Instruments 21, 976-7(1950) Dec.

A particularly simple cloud chamber is described which is continuously sensitive to ion tracks. The chamber operates on the principle of vapor diffusion from a hot to a cold surface. The sensitive region is a shallow horizontal layer near the cold surface. The chamber has been placed in a magnetic field, and curved tracks of β particles from a radioactive source have been photographed. Pictures (2) of such electron tracks are shown. (auth)

2853

CONTINUOUSLY SENSITIVE DIFFUSION CLOUD CHAMBERS. E. W. Cowan. Rev. Sci. Instruments 21, 991-6 (1950) Dec.

The following types of continuously sensitive diffusion cloud chambers have been built and successfully operated: a chamber designed to be photographed through the top for use with a particle accelerator, a chamber designed to be photographed from the side for cosmic-ray studies, and a very simple chamber for demonstration purposes. The construction and best operating conditions are described. 7 figures. (auth)

2854

DELAYED-COINCIDENCE MEASUREMENTS FOR DETERMINING THE HALF-LIVES OF SHORT-LIVED METASTABLE NUCLEI (ISOMERS). Arne Lundby. In Forsvarets Forskningsinstitutt, Årbok 1947, 13-23.

Preliminary studies on short-lived nuclei, especially isomers, by delayed-coincidence methods are reported. Two procedures are described, distinguished as "differential" and "integral," and as a test the half-life of RaC' (Po^{214}) was measured; the value found was 1.47×10^{-4} sec.

2855

Naval Radiological Defense Lab.
DESIGN REQUIREMENTS FOR EXTENDED-SOURCE SCINTILLATION COUNTERS. R. H. Davis. Nov. 10, 1950. 20p. (AD-277(I))

An α-survey instrument should be designed to minimize the time required to survey a given area rather than to maximize its counting rate. It is, therefore, necessary to maximize the product of the counting rate and the sensitive area, the sensitive area being the area by which the maximum counting rate per unit scintillation area must be multiplied to give the total counting rate. The optimum detector using a "light-funneling" system and an RCA 1P21 photomultiplier tube was obtained with a cylindrical "funnel" 3 in. diam and 1.6 in. long. (auth)

2856

ELECTRONIC ACCESSORIES FOR GEIGER-MÜLLER COUNTERS. Håkon Harbek. In Forsvarets Forskinings-institutt, Årbok 1947, 24-37. (In Norwegian)

A general outline of principal circuits to be used as amplifiers and scaling devices in connection with G-M counters is given.

2857

ERRORS DUE TO SCATTERING IN THE EVALUATION OF CLOUD-CHAMBER TRACKS IN A MAGNETIC FIELD. W. Bothe. Sitzber. heidelberg. Akad. Wiss., Math.-naturw. Klasse, 107-18(1948). (In German)

Several procedures are suggested for the determination of the error made when measuring from cloud-chamber data the radius of the trajectory of a particle in a magnetic field. The error is due to the distortion of the circular trajectory caused by multiple scatterings of the particle by atoms of the gas filling the chamber. To cite one of the procedures, the circle fitted to the track is tangent to it at one of its ends and is so chosen as to minimize the integral of the squares of the deviations, taken over the entire length of the track; the operation is repeated for the other end, and from the average of the two radius measurements, the mean square error is calculated with the aid of a special graph.

2858

FLUORESCENCE OF SOLUTIONS BOMBARDED WITH HIGH ENERGY RADIATION (ENERGY TRANSPORT IN LIQUIDS). PART II. Hartmut Kallmann and Milton Furst. Phys. Rev. 81, 853-64(1951) Mar. 1. (See also NSA 4-5950)

In organic solutions containing fluorescent molecules a considerable part of the high-energy radiation absorbed in the bulk material is transformed into light emitted by the fluorescent molecules. There is a transfer of excitation energy from the bulk material to these molecules which reaches its maximum at concentrations of approximately 1 g/liter and higher. Experiments with mixed solvents are described where relatively small concentrations (several mole per cent), especially of naphthalene and o-diphenylbenzene, act in some way as a second solvent. The excitation energy can be localized by investigating the fluorescence of these mixed solvents when different fluorescent solutes are added. It is found that the energy migrates from the original solvent to the second solvent and then to the fluorescent molecule. This intermediate energy transfer can change the light-emission curve completely. From this change the dependence of the light emission on internal and self-quenching could be determined. Besides this internal energy transfer, an energy transfer via radiation occurs which is described in detail by studying the absorption of the fluorescent light inside the solution by adding small amounts of a second solute of the order of 0.1 g/liter. Such small amounts change the light intensity considerably and shift the spectrum to the spectrum of the second solute.

Photographs and data of the spectral distribution of such solutions are presented which show that such drifts already occur with very small amounts of the second solute. (auth)

2859

THE INFLUENCE OF THE TIME-LAG FLUCTUATIONS IN GEIGER COUNTERS ON DELAYED COINCIDENCE MEASUREMENTS. Arne Lundby. In Forsvarets Forsknings-institutt, Årbok II, 1948-49, 29-46.

Continuing a theoretical and experimental examination of delayed-coincidence methods (see Forsvarets Forsknings-institutt, Årbok 1947, 13, the author makes a detailed analysis of their limitations in the determinations of short lifetimes.

2860

Columbia Univ.
INSTRUMENT DEVELOPMENT, sect. V of PROGRESS REPORT; NUCLEAR PHYSICS LABORATORIES. J. R. Dunning, Director. Sept. 30, 1950. 5p. (CUD-61(sect. V))

A ten-channel pulse-height discriminator having stable characteristics and high resolution, which is being used in a γ-ray spectroscope, was developed. In addition, a single-channel unit was developed for use in β-ray spectroscopy and the neutrino experiment. A sweep circuit of special design was incorporated into a high-speed synchroscope and is being used for meson measurements. In addition, considerable progress has been made on a wide-band-distributed amplifier and a high-resolution coincidence circuit, both of which were brought near to completion during this period. The wide-band amplifier, which uses a new "pencil" triode, is expected to have a bandwidth in excess of 500 Mc, and the coincidence circuit is expected to have a resolution of $\sim 10^{-9}$ sec. Other apparatus development, such as the linotron model and the electronic cyclotron target tester, awaited material procurement or machine-shop fabrication during this period. (auth)

2861

THE MEASUREMENT OF X AND GAMMA RADIATION OVER A WIDE ENERGY RANGE. THE SILVANUS THOMPSON MEMORIAL LECTURE. Lauriston S. Taylor. Brit. J. Radiology 24, 67-81(1951) Feb.

The general subject of measurement of x and γ rays having energies beginning at a few thousand volts and ranging up to several million volts, as seen from the point of view of the National Bureau of Standards, is discussed. The status of investigations being carried out on low-voltage standards, measurement of very high dosage rates, 500-kv standards, secondary standards, effects of undersaturation, vacuum chambers, secondary instrumentation, Geiger and scintillation counters, photographic emulsions, and miscellaneous problems is presented.

2862

A NEW METHOD OF USE OF THE PHOTOGRAPHIC FILM AS QUALITY INDICATOR AND DOSE METER FOR X- AND GAMMA RAYS. G. Spiegler. Phot. J. 90B, 166-71(1950) Nov.-Dec.

A new photographic method for the determination of the quality of x and γ radiations is described. Use is made of the variation of the electronic emission from metal foils with wavelength. The intensifying factor under a tin foil used as a front screen serves as an indicator of the quality, an electron-stopping filter across a Pb foil at the back of the film permitting discrimination between high-energy quanta and the region of x rays. The method permits determination of the quality of the radiation scattered outside the primary beam and outside the irradiated object. Applications of the method and protection problems are discussed.

2863

THE PRINCIPLES OF CLOUD-CHAMBER TECHNIQUE. J. G. Wilson. Cambridge, Cambridge University Press, 1951. 131p.

The monograph contains discussions of the condensation of vapors, the growth of liquid droplets, the ionization of gases by fast charged particles, the various means used for the production of a supersaturated vapor, the basic principles of operation of cloud chambers to obtain good tracks, the optics involved in photographic recording of cloud tracks, the value of counter control of cloud chambers, and the technique of precision measurements. A short account of some of the factors entering into the interpretation of cloud-chamber photographs is included as final chapter. A more complete review by Raymond V. Adams may be found in Am. Scientist 39, 328(1951) Apr.

2864

PROPAGATION OF THE DISCHARGE IN EXTERNAL-CATHODE GEIGER-MUELLER COUNTERS. Maurice Schérer and Elisabeth Vieille. Compt. rend. 231, 964-6 (1950) Nov. 6. (In French)

Craggs and Jaffe (Phys Rev. 72, 784(1947)) investigated the photoelectric effect of the cathode on the discharge in organic vapors by using a divided brass cathode inside a glass tube. The present experiment uses separated graphite cathodes on the outside of a glass tube containing a tungsten-wire anode divided into corresponding sections by nylon beads. By irradiating one section with γ rays and observing double coincidences between sections, the authors have found the propagation of the discharge in this assembly to be similar to that observed by Craggs and Jaffe, but greater. The glass wall therefore does not act as an absorbent but gives rise to a photoelectric effect at least as great as that of brass.

2865

NEPA Div.
THREE CRYSTAL SCINTILLATION SPECTROMETER. Joe Keagy Bair and Fred C. Maienschein. Nov. 27, 1950. 7p. (NEPA-1638)

A three-crystal scintillation spectrometer has been constructed. This instrument will measure γ-ray energies by pair production, in addition to operating as the more usual Compton spectrometer. It has other features desirable for work in the intermediate region where Compton and pair processes give comparable peaks. NaI crystals and RCA 5819 photomultiplier tubes are used. A schematic diagram of a particular geometry is given, and the spectrum of ThC″ (Tl^{208}) determined with this arrangement is compared with that taken with a two-crystal spectrometer.

2866

Division of Mathematical and Physical Sciences, NRC
RECENT APPLICATIONS OF ELECTRON-MULTIPLIER TUBES. (Preliminary Report No. 10; Nuclear Science Series). James S. Allen. Dec. 1950. 15p. (NP-1968)

Recent applications of the electrostatic electron-multiplier tube to problems which require the measurement of very small currents or the counting of single ions or electrons are described. The characteristics of secondary-electron-emitting surfaces suitable for use in multiplier tubes are discussed in the first section. The next section is devoted to recently developed tubes having one or more stages of electron multiplication. Following this is a section dealing with the application of these tubes to problems involving electron and ion counting. The review is concluded by a section on the statistical treatment of the distribution in pulse sizes from multiplier tubes. 20 figures. (auth)

2867

SCINTILLATIONS PRODUCED IN LIQUIDS BY HIGH-ENERGY RADIATION: $\alpha\alpha'$ DINAPHTHYL AS A SCINTILLATING MEDIUM. E. H. Belcher. Nature 167, 314(1951) Feb. 24. (Letter to the editor)

A wide variety of solutions of organic compounds known or suspected to have fluorescent properties has been examined in an effort to find a suitable liquid medium to replace the crystalline luminophors at present used in scintillation counters. A small sample of each liquid was irradiated by γ radiation from a standard source of Co^{60}, and the counting rate produced by the γ radiation was measured. Of the systems investigated, $\alpha\alpha'$dinaphthyl in benzene was found to be the most promising.

2868

A SEMI-AUTOMATIC DEVICE FOR ANALYZING EVENTS IN NUCLEAR EMULSIONS. Marietta Blau, Robert Rudin, and Seymour Lindenbaum. Rev. Sci. Instruments 21, 978-85(1950) Dec.

An apparatus is described, the basic element of which is a microscope with a motor-driven stage. The operator controls the direction and speed of motion by a steering wheel and an accelerator pedal and drives the track to be analyzed through a target. Range, grain density, and geometrical orientation of tracks, etc., are automatically recorded on charts. Methods of measurements and results are discussed. 10 figures. (auth)

2869

STATISTICAL DISTRIBUTION OF ALPHA PARTICLES REGISTERED ON A PHOTOGRAPHIC PLATE, AS A FUNCTION OF TRACK PROJECTIONS. G. Imbò and L. Casertano. Ann. geofis. (Rome) 3, 475-83(1950) Oct. (In Italian)

For the purpose of determining the content of specific radioactive elements in rock formations, curves were obtained giving the distribution of α particles as a function of the tracks' projections on the photographic plate's surface. The problem was studied both for the case of single elements and for radioactive families in equilibrium. (auth)

2870

NEPA Div.
TWO-CRYSTAL SPECTROMETER RESULTS WITH UNCOLLIMATED GAMMA-RAYS. Joe Keagy Bair, Fred C. Maienschein, and William B. Baker. Oct. 27, 1950. 6p. (NEPA-1609)

The γ-ray spectra of Cs^{137} and Co^{60}, as obtained with a two-crystal Hofstadter-type spectrometer, are shown. The point source of γ rays was located several inches from a 1-in.-diam 1-in.-high Compton-electron counting cyrstal. The degraded-γ counting crystal, 1.5 in. diam and 1.5 in. high, was located 2.75 in., center to center, from the 1-in. crystal and at an angle of about 150 deg with the direction of the incident γ rays. Experimental and calculated efficiencies agree, giving a figure of about 0.003 cps in the peak for unit flux at the Compton-scattering crystal. An uncollimated single-crystal spectrum of Co^{60} taken with a 1.5-in.-diam and 1.5-in.-high crystal is also shown. Presumably the uniformity of the raw crystal material, surface conditions, and mounting have more effect on the resolution than crystal size.

2871

VARYING NUCLEAR EMULSION SENSITIVITY WITH ALTITUDE. Arthur Beiser. Rev. Sci. Instruments 21, 1025-6(1950) Dec.

The dependence of the sensitivity-reducing action of photographic desensitizers on oxygen concentration (Blau and Wambacher, Nature 134, 538(1934)) suggests the possibility of limiting the sensitivity time of nuclear emulsions by the use of such agents. The dyes used for this purpose apparently act as catalysts for the oxygen in its reaction with the emulsion and are capable of preventing the formation of a latent image although not ordinarily sufficient to attack an existing one. Since the density of atmospheric oxygen varies with altitude, the use of desensitizers is of special interest in connection with balloon and perhaps also airplane and rocket flights with nuclear plates. Tests under simulated balloon-flight conditions are described.

MESONS

2872

Radiation Lab., Univ. of California
ENERGY SPECTRUM AT 18° OF MESONS PRODUCED IN PROTON-PROTON COLLISIONS. (abstract) Vincent Peterson, Edwin Iloff, and Dora Sherman. Dec. 15, 1950. 1p. (UCRL-1041)

The report is reproduced here in its entirety.

Using a liquid hydrogen "point" source and photographic-plate method of detection described earlier (Post-deadline paper by V. Peterson at 1950 Washington, D. C., meeting; abstract N3, Bull. Am. Phys. Soc. 25, No. 4, 21(1950)), the energy spectrum of positive mesons produced from 340-Mev proton bombardment has been measured at a laboratory angle of 18 ± 0.85 deg. Improvements in the energy and angular resolution of the detector geometry have resulted in narrowing the half-width of the sharp peak at the

upper end of the spectrum to ±1.8 Mev, most (if not all) of which is due to the energy spread of the primary proton beam. Present uncertainties in the meson mass and absolute accuracy of the proton range-energy relationship prevent the use of energetics in determining the existence of $p + p \rightarrow d + \pi^+$; however, if independent experiment confirms that the peak corresponds to this reaction, then the mean energy is a sensitive measure of meson mass. The integrated cross sections at 18 and 30 deg are, respectively, 0.163 and 0.058 mb/ster (+15%, −5%). The degree ratio 18/30 = 2.8 favors a cos θ angular distribution in the center-of-mass system.

2873

Radiation Lab., Univ. of California
ON THE BRANCHING RATIO OF THE π^+ MESON. Frances M. Smith. Jan. 4, 1951. 3p. (UCRL-1074)

Early experiments on π^+ mesons, using photographic emulsions as detectors, have seemed to show that some of the π^+ mesons, upon stopping in matter, do not decay into μ^+ mesons. Ilford G5 and Eastman NTB3 emulsions were chosen for the present study. The apparatus was of such dimensions that only π^+ mesons from the target with energies between 6 and 8 Mev could enter the emulsion after a turn of 180 deg. Analysis of results consisted in calculating the number of background μ mesons expected to fall in the main distribution. This number was subtracted from the number of mesons showing no decay found in the main distribution. A preliminary estimate of the percentage of π mesons from the target which do not decay into μ mesons is R = 0.3 ± 0.4%. This indicates that the branching ratio of the π^+ mesons is less than 1% and probably zero.

2874

Radiation Lab., Univ. of California
MESON PRODUCTION ACCOMPANYING URANIUM FISSION. H. Bradner and J. K. Bowker. Jan. 26, 1951. 4p. (UCRL-1102)

The direct production of a π meson in U fission, although energetically possible, was not considered seriously until the event illustrated in this report was discovered in a U-loaded plate exposed to cyclotron mesons. A 5-Mev meson is shown coming from a fissioning nucleus. Two experiments were performed to search for such mesons. The results of placing G5 and C2 emulsions next to a sheet of 94% U^{235} exposed to a paraffin-moderated Po-Be source show that the probability for producing mesons is less than 8×10^{-7}. A beam of π^- mesons produced in a conventional channel arrangement inside the 184-in. cyclotron was stopped in a ⅛-in.-thick slab of ordinary U metal. Secondary mesons up to approximately 30 Mev produced in the slab could be observed in a C2 emulsion embedded in absorber beyond the U, but none of the secondary mesons observed came from the direction of the U slab. It can be inferred that the original event observed was a "direct production" of a meson from a fast neutron striking a nucleon in U and was not directly associated with the fission.

2875

ON THE COUPLING SCHEME OF MESONS. Walter Thirring. Z. Naturforsch. 6a, 53-4(1951) Jan. (Note; in German)

Of the two coupling schemes permitting the incorporation of μ mesons into meson theory (Yukawa, Revs. Modern Phys. 21, 474(1949)), one (scheme I) has the advantage of leading to equal interactions between all Fermi particles; however, although describing β decay, μ-meson decay, and μ-meson capture, it furnishes no information, for reasons of divergences, on the $\pi \rightarrow \mu$ decay as does scheme II. An analysis of the latter decay in the framework of scheme I shows that the ratio between probabilities of $\pi \rightarrow \mu$ and $\pi \rightarrow$ electron decays can be made independent of any divergent expressions; however, its value is found to differ too much from the real one to warrant any preference for the otherwise more satisfactory scheme I. This result was obtained by the author independently of a similar one published by Schiff (Phys. Rev. 76, 303(1949)).

2876

ON THE DISINTEGRATION OF THE HEAVY POSITIVE MESON. Elisa Frota Pessoa and Neusa Margem. Anais acad. brasil. cienc. 22, 371-83(1950) Dec. 31. (In Portuguese)

According to observations of the Berkeley group, the disintegration of positive π mesons resulted, in 95% of cases, in the formation of a μ^+ meson (the latter disintegrating with the production of a positron). In the remaining 5% the track ended in the emulsion with no visible continuations, and it could be surmised that in these cases a direct formation of positrons, which remained invisible because of insufficient sensitivity of the emulsion, took place. Measurements are described here of tracks that have been obtained on better plates, in Berkeley, through a bombardment of C with 350-Mev protons. In all 200 events examined the disintegration ended in the formation of a μ^+ meson. A new phenomenon of a creation of a π^+ meson within the emulsion was observed in one case.

2877

ON THE PRODUCTION OF MESONS BY PHOTONS. J. Serpe. Physica 16, 890-4(1950) Dec. (In French)

The production of π mesons in collisions between photons and nuclei has been investigated, the nuclei being considered as a Fermi gas at 0°K. The conclusions, which, in the approximation adopted, are valid for all types of meson theory, are compared with some recent experimental results of Steinberger and Bishop (Phys. Rev. 78, 494(1950)). (auth)

MICROWAVES

2878

A FREQUENCY METER FOR MICROWAVE SPECTROSCOPY. John D. Rogers, Henry L. Cox, and Paul G. Braunschweiger. Rev. Sci. Instruments 21, 1014-15 (1950) Dec.

A frequency meter using known absorption lines as microwave frequency standards has been developed. By mixing signals of unknown microwave frequency f_x, standard microwave frequency f_0, and known r-f signals nf_c from a crystal-controlled harmonic generator, it is possible to obtain a set of "beat" frequencies f_r which can be detected by a calibrated radio receiver. From the relation f_r =

$\pm m(f_x - f_o) \pm nf$ it is possible to determine values for the unknown microwave frequency f_x. Tests on methanol absorption lines with ammonia lines as microwave frequency standards show that microwave frequencies can be determined to ±0.03 Mc/sec. Advantages of this device over other frequency meters are discussed; the accuracy is ultimately limited by the uncertainties in the value of the standard frequency f_o. (auth)

NEUTRONS

2879

Los Alamos Scientific Lab.
ENERGY SPECTRUM OF NEUTRONS FROM FISSIONS INDUCED BY THERMAL NEUTRONS. B. E. Watt. [nd.] Decl. Feb. 26, 1951. 51p. (AECD-3073; LADC-935)

A proton-recoil counter has been used to determine the neutron spectrum, in the energy range 3.3 to 17 Mev, of a beam produced by irradiating 95% U^{235} (metal) in the water boiler; most of the fissions were induced by slow neutrons. The data obtained are believed to represent the fission spectrum and are combined with data obtained by other investigators. The composite spectrum so obtained extends from 0.075 to 17 Mev. Fits with two general formulas are discussed. (auth)

2880

Brookhaven National Lab.
LONG PERIOD DELAYED NEUTRONS. (abstract) J. W. Kunstadter, J. J. Floyd, L. B. Borst, and G. J. Weremchuk. Feb. 27, 1951. 1p. (AECU-1196)

The report is reproduced here in its entirety.

The neutron density at a point in the Brookhaven reactor has been measured with indium foils as a function of time after a rapid shutdown. Neutrons of low yield and long half-life were observed after the decay of the groups of up to 55-sec half-life previously reported (Hughes et al., Phys. Rev. 73, 111(1948); Sun et al., Phys. Rev. 79, 3(1950)). Three groups of neutrons were found by a peeling-off process on data obtained after varying lengths of reactor operation time. The half-lives are about 3, 12, and 120 min, and the yields relative to the 55-sec group are $1 : 3 \times 10^{-5} : 10^{-7} : 5 \times 10^{-9}$, with no correction for the unknown neutron energies. The limits of error are estimated to be 15% in the half-lives and 25% in the yields. No known fission-product γ rays are recorded which can give photo neutrons or photo fission with these characteristics.

2881

Oak Ridge National Lab.
NEUTRON PHYSICS AND LOW TEMPERATURES, p.32-48 of QUARTERLY PROGRESS REPORT FOR PERIOD ENDING SEPTEMBER 20, 1950; PHYSICS DIVISION. L. D. Roberts, J. W. T. Dabbs, Jr., T. E. Stephenson, S. Bernstein, C. P. Stanford, and L. W. Cochran. Jan. 8, 1951. 17p. (ORNL-865(p.32-48))

When a beam of polarized neutrons is projected through a metal-Dewar-flask system, the neutron polarization remains essentially unaffected. The Dewar flasks contain approximately 1 liter of liquid helium and have a satisfactorily low liquid-helium loss rate. Equipment for the observation of nuclear alignment in a sample of manganous ammonium sulfate is described. To observe nuclear alignment, the activity of manganous ammonium sulfate activated with its nuclei presumably polarized is compared to the activity of the same manganous ammonium sulfate sample activated a second time with its nuclei unpolarized. An expression for the intensity and polarization of an initially unpolarized beam of neutrons after passing through a block of magnetized iron has been set up. In these equations j and j_o are measurable quantities, being the counting rates with iron magnetized and not magnetized, respectively. Measurements of j and j_o were made for five different thicknesses of steel at a neutron energy of 0.0261 ev. The magnet currents required to produce a field of 10,500 gauss for each sample are given. The experimental arrangement for measuring the single transmission effect at a given neutron energy is shown. Measurements were made with a crystal angle of 22.5 deg, corresponding to a neutron energy of 0.0261 ev (λ = 1.77 A, neutron velocity of 2230 m/sec). The data are summarized. Other calculations and pertinent data are expressed.

2882

Oak Ridge National Lab.
NEUTRON DIFFRACTION, p.49-55 of QUARTERLY PROGRESS REPORT FOR PERIOD ENDING SEPTEMBER 20, 1950; PHYSICS DIVISION. C. G. Shull, E. O. Wollan, W. C. Koehler, and W. A. Strauser. Jan. 8, 1951. 7p. (ORNL-865(p.49-55))

According to the theory of magnetic scattering of neutrons by ferromagnetic materials, there should exist partial polarization in the neutrons scattered by a single ferromagnetic domain. For the case of Bragg scattering by Fe, the expected polarization in the strong 110 reflection is calculated to be 60%. Attempts have been made to measure this polarization by studying its passage through various samples of magnetized and unmagnetized analyzing blocks of iron. It was not feasible to use a single crystal of Fe as the source of unpolarized radiation because of the extreme difficulty encountered in demagnetizing the single crystal. Accordingly, a nonferromagnetic crystal (Cu in 111 reflection) was used for this. Measurements were then made of the single transmission effect in the analyzing block with polarized radiation from the Fe crystal and with unpolarized radiation from the Cu crystal. These two measurements permit calculation of the degree of polarization in the polarized beam. It was determined that the Bragg-reflected beam from magnetized iron is polarized, but the degree of polarization is uncertain. By measuring the crystal-structure amplitudes of iron over a range of scattering angles, it has been possible to determine the magnitude and angular dependence of the magnetic scattering as well as the angularly independent nuclear scattering. The scattering data obtained from powdered iron are plotted. These data represent an average from several samples of iron prepared in different ways and of particle size ranging from very fine powders to coarse filings. The angularly dependent items of the data, which represent even at small angles only about 10% of the total differential scattering cross section, are due to magnetic scattering. The solid curve in the figure has been calculated for the magnetic scattering amplitude with numerical values for the form factor taken from the average of the curves calculated by Steinberger and Wick (Phys. Rev. 76, 994

(1949)) on the assumption of different boundary conditions for their wave functions. Good agreement is noted between the data and the average form-factor curve. Samples of Fe_2O_3 of known enrichment in Fe^{54}, Fe^{56}, and Fe^{57} were analyzed for purity by spectroscopic and x-ray-diffraction studies. Neutron-diffraction patterns were first obtained with the oxide samples in order to determine the scattering phases of the isotopes, and these samples, as well as a sample of normal iron oxide, were reduced to the metal powder, with which more extensive and accurate intensity studies of the diffraction patterns were made. The data for Fe^{56} were analyzed in the same way as for normal iron, and the magnetic intensity was found to follow, within experimental error, the same curve. All the nuclear data are given in a table.

2883

Oak Ridge National Lab.
SEARCH FOR A PERMANENT ELECTRIC DIPOLE MOMENT OF THE NEUTRON, p.62 of QUARTERLY PROGRESS REPORT FOR PERIOD ENDING SEPTEMBER 20, 1950; PHYSICS DIVISION. J. H. Smith. Jan. 8, 1951. 1p. (ORNL-865(p.62))

Direct measurement of the permanent electric dipole moments of nucleons or nuclei has been attempted. The experiment is similar to molecular-beam-resonance techniques for studying the magnetic moment of the neutron but further modified by employing a split-oscillating-field technique. This allows the use of a much longer (6-ft) homogenous magnetic field with proportional increase in sharpness of the resonance. It also allows a vacuum absorber containing a high-voltage condenser to be placed in the region between the oscillating fields. The neutrons pass through this electric field of 10^5 volts/cm, and if the neutron has a permanent electric dipole moment, a reversal of the direction of this electric field should result in a shift of the magnetic dipole resonance.

2884

Oak Ridge National Lab.
THERMAL NEUTRON DIFFUSION IN WATER, p.63 of QUARTERLY PROGRESS REPORT FOR PERIOD ENDING SEPTEMBER 20, 1950; PHYSICS DIVISION. F. J. Sisk. Jan. 8, 1951. 1p. (ORNL-865(p.63))

This section of the report is reproduced here in its entirety.

In order to study in a precise way the diffusion of thermal neutrons in water, the following problem was attacked both experimentally and theoretically: What is the thermal-neutron-flux distribution in water (23°C) in the vicinity of an infinite-plane black absorber (cadmium) situated at $x = 0$ when the asymptotic flux (far from the plane) is given by e^{kx}? This situation was realized experimentally to a good approximation in the large water tank on top of the thermal column of the Oak Ridge graphite reactor. The neutron-flux distribution was measured by activation of small, thin indium foils at various distances below a circular cadmium plate. In order to normalize the results to constant incident current, two monitor foils at fixed positions were also exposed for each run. In this way the flux depression due to the cadmium plate was rather accurately determined as a function of distance from the plate. At $x = 0$ the normalized flux was measured and found to be 18.3% of what it would have been with the plate removed. The theoretical approach to the problem consisted in setting up the integral equation of transport theory with an exponential integral kernel for this situation and carrying through a solution with assumed eigenvalue $\Sigma_a/2\Sigma$ by a numerical iteration method. Excellent agreement between the observed and theoretical flux distributions is obtained with $\Sigma_a/2\Sigma = 0.496$. This provisional value, together with the measured value of $k = 0.373\ cm^{-1}$, leads to the following values for the equivalent scattering and absorption cross sections (per hydrogen atom) for water: $\Sigma_s \approx 45$ barns, $\Sigma_a \approx 0.25$ barn. Additional refinements in the calculations may change these values slightly.

2885

ABSOLUTE YIELD OF PHOTONEUTRONS FROM VARIOUS ELEMENTS. B. R. Uspekhi Fiz. Nauk 42, 166-8(1950) Sept. (In Russian)

Two papers on the dependence of the yield of neutrons produced in (γ,n) reactions on the atomic number are reviewed, viz. Price and Kerst, Phys. Rev. 76, 182A(1949), and Baldwin and Elder, Phys. Rev. 78, 76(1950). The dependence is of the form $N = aZ^b$, which is close to the formula calculated from the theory of Goldhaber and Teller (Phys. Rev. 74, 1046(1948)) on the dipole character of oscillations produced in a nucleus by a γ quantum.

2886

UPPER LIMIT FOR THE TIME BETWEEN FISSION AND THE EMISSION OF NEUTRONS. Thoma M. Snyder and Robert W. Williams. Phys. Rev. 81, 171-4(1951) Jan. 15.

The Baker experiment to detect times of delay greater than $\sim 5 \times 10^{-9}$ sec for the emission of fission neutrons has been performed by observing the change in fission-neutron counting rate when fission fragments are allowed to fly away from a neutron counter as compared to the counting rate when the fragments are kept in the vicinity of the counter. The fission neutrons were detected by observing proton recoils in a thick-paraffin-lined proportional counter. The per cent of neutrons delayed by a time of at least 8×10^{-9} sec was found to be 3.6 ± 2.8 [%]. (A more complete account can be found in the AEC declassified document LADC-252.) (auth)

NUCLEAR PHYSICS

2887

Oak Ridge National Lab.
THEORETICAL PHYSICS, p.64-76 of QUARTERLY PROGRESS REPORT FOR PERIOD ENDING SEPTEMBER 1950; PHYSICS DIVISION. M. E. Rose, J. M. Jauch, S. D. Drell, G. B. Arfken, Jr., and L. C. Biedenharn, Jr. Jan. 8, 1951. 13p. (ORNL-865(p.64-76))

The problem of quenching of the orbital motion of a paramagnetic ion was investigated, and a simple systematic treatment of this problem was developed with the methods of quantum mechanics. The theory was then applied to the problem of the Cu-Tutton salts and $CuSO_4 \cdot 5H_2O$ where results for the anisotropy of the g factors can be derived with

this method. In the course of this work, it was observed that there exists a large interaction between the Cu ions in the undiluted salt, which must be of the superexchange type. There are four independent physical phenomena which confirm this interaction. The hyperfine structures of the Mn^{++} and Cu^{++} ions were investigated. In both these cases previous theories were in disagreement with experiment, giving zero splitting for Mn and a splitting for Cu which varies in the opposite direction with the g factor. The value for the hyperfine structure splitting in the directions parallel and perpendicular to the tetragonal axis is reported to be about 6 experimentally, about ½ with the old theory, and about 5 with a new theory. Discussions of internal conversion, zero-zero transitions, reactions and theorems of nuclear processes, angular dependence on γ emission, and collecting efficiency in neutron decay studies are included.

2888

Radiation Lab., Univ. of California
DETECTION OF γ-RAY POLARIZATION BY PAIR PRODUCTION. G. C. Wick. Nov. 28, 1950. 5p. (UCRL-1031)

The azimuthal dependence of the pair-production cross section $d\sigma$, the azimuths ϕ_+ and ϕ_- for the positive and negative electron, respectively, being measured around the direction $\vec{k}$ of the incident quantum and from the plane containing $\vec{k}$ and the electric polarization vector $\vec{\epsilon}$ of the quantum, may provide a method for detecting the polarization of γ rays in the high-energy range. Berlin and Madansky (Phys. Rev. 78, 623(1950)) have made a careful study of the dependence of $d\sigma$ on ϕ_- when $\phi_+ = \phi_- + \pi$. Since from the experimental standpoint it will be practically impossible to select the pairs which satisfy the Berlin-Madansky condition, the measurement of the angle between the plane of the pair and the plane of polarization without any selection is considered. The question then arises whether the case considered by these authors is sufficiently representative to permit a rough prediction of what to expect in the general case. The results of a calculation using the Weizsaecker-Williams approximation may indicate that it is not. It is believed that the Berlin-Madansky conclusions apply only if the condition they postulate ($\phi_+ = \phi_- + \pi$) is strictly satisfied.

2889

EINFÜHRUNG IN DIE KERNPHYSIK. Wolfgang Riezler. Berlin, Herman Hübener Verlag, 1950. 309p. (In German)

This book is descriptive and chiefly for the nonspecialist. It is arranged in two parts, the first dealing with such matters as properties of nuclei, natural radioactivity, nuclear transformation, and basic ideas of the build-up of nuclei. The second part is concerned with the methods used in nuclear investigations, the obtaining of fast particles, neutron sources, and detection of particles. One chapter is devoted to the applications of radioactive isotopes and is supplemented by a simple graphic representation of the isotopes.

2890

Columbia Univ.
NEUTRON VELOCITY SPECTROMETER TRANSMISSION MEASUREMENTS, sect. I of PROGRESS REPORT; NUCLEAR PHYSICS LABORATORY. J. R. Dunning, Director. Sept. 30, 1950. 3p. (CUD-61(sect. I))

Data obtained on Mo show the presence of a resonance at about 50 ev. Changes have been made in both the circuits and types of tubes used in the velocity selector in order to give more reliable operation over long and continuous periods of running. A sample is in preparation which will be used for an accurate measurement of the capture cross section of B. A collimating and shielding system is under construction for the para-hydrogen experiment, and equipment is being designed to provide recirculation of the neon refrigerant. Neutron-diffraction studies on vitreous silica are continuing. A strong resonance was found in Te at 2.2 ev, and several smaller resonances were found at higher energies. Theoretical calculations are being made on the inelastic-scattering cross section of Pb. (auth)

2891

NUCLEAR MODELS. Victor Weisskopf. Science 113, 101-2(1951) Jan. 26.

A discussion of nuclear structure which introduces oversimplified nuclear models classified into (a) the independent particle viewpoint (I.P.) and (b) the strong interaction viewpoint (S.I.) is presented. Contradictory aspects of the two viewpoints are reviewed.

2892

NUCLEAR PHYSICS. Enrico Fermi, notes compiled by Jay Orear and others. Chicago, Univ. of Chicago Press, 1950. 246p.

The following book note appears in Nucleonics 7, No. 1, 84(1950) July. "Only a relatively few students are privileged to attend Professor Fermi's brilliant lectures at the University of Chicago; it is therefore a distinct contribution to the followers of nuclear science that his lecture material has been systematically organized in a publication and made available to a much wider audience."

2893

NUCLEAR PHYSICS; a Textbook. Francis Bitter. Cambridge, Mass., Addison-Wesley Press, 1950. 200p.

The following is extracted from a book note appearing in Science, 369(1950) Sept. 29: "The presentation is direct and simple and shows an understanding of the problems met by students of a first course in nuclear physics. Although the book will serve to stimulate rather than satisfy the student's interest in the topics discussed, it should give those in other fields a reasonably complete and accurate picture of the present status of nuclear physics. It is recommended that those teaching an introductory or descriptive course in nuclear physics give it serious consideration."

NUCLEAR PROPERTIES

2894

MEASUREMENT OF THE MEAN LIFE OF THE 6 $^3P_1$ RESONANCE LEVELS OF THE MERCURY ISOTOPES. Robert Lennuier and Jean-Louis Cojan. Compt. rend. 231 1450-2(1950) Dec. 18. (In French)

The isotopic hyperfine components of Hg radiation have been isolated with a two-field magnetic filter, and the mean

life τ of the $^3P_1$ level has been shown to vary with the nuclear spin i of the isotope. For the even isotopes (i = 0), $\tau = 1.10 \times 10^{-7}$ sec; for Hg^{199} (i = ½), $\tau = (1.45 \pm 0.05) \times 10^{-7}$ sec; and for Hg^{201} (i = ⅜), $\tau = (2.25 \pm 0.10) \times 10^{-7}$ sec.

2895

Los Alamos Scientific Lab., and Ballistics Research Labs., Aberdeen Proving Ground
TABLE OF ATOMIC MASSES. N. Metropolis and G. G. Reitwiesner. Mar. 1950. 472p. (NP-1980)

A new table of atomic masses, based on a semiempirical formula of Fermi, has been prepared with the aid of the Eniac computer. The expression for the mass M as a function of the atomic number A and nuclear charge Z is given by

$$M(A,Z) = 1.01464\,A + 0.014\,A^{2/3} - 0.041905\,Z_A + \frac{0.041905}{Z_A}(Z - Z_A)^2 + \lambda\frac{0.036}{A^{1/4}}$$

where

$$Z_A = \frac{A}{1.980670 + 0.0149624\,A^{1/3}}$$

and

$$\lambda = \begin{cases} +1 & \text{A even, Z odd} \\ -1 & \text{A even, Z even} \\ 0 & \text{A odd} \end{cases}$$

The present table represents an improvement and extension of a previous one where primarily neutron-rich masses were computed. The data are given in two forms: first according to A, with the associated isobars in order of increasing Z. Mass differences are also given. The second part of the table has the masses arranged according to Z, with the corresponding isotopes in order of increasing A.

NUCLEAR REACTORS

2896

Los Alamos Scientific Lab.
RELATIVE EFFECTIVENESS OF DELAYED NEUTRONS IN THE WATERBOILER. F. de Hoffmann. Dec. 13, 1945. Decl. Jan. 18, 1951. 5p. (AECD-3042; LADC-817)

A first-approximation theoretical calculation for the quantity γ of the water boiler is given. $\gamma = P_d/P_p$, where P_p = average probability that a neutron when born promptly has of eventually producing a fission and P_d is the corresponding quantity for a delayed neutron. γ is in essence the effectiveness of the delayed compared with that of the prompt neutrons.

2897

Los Alamos Scientific Lab.
CRITICALITY OF THE WATER BOILER AND EFFECTIVE NUMBER OF DELAYED NEUTRONS. (Expanded version of MDDC-383) F. de Hoffmann. Dec. 8, 1944. Decl. Jan. 30, 1951. 49p. (AECD-3051; LADC-816)

The calibration of the water boiler was made in such a way as to refer eventually to the multiplication of the primary-neutron source. The effective number γf of delayed neutrons in the water boiler was found to be 0.855%. Here f was the fraction of delayed neutrons emitted on fission, and γ was the relative effectiveness of delayed and prompt neutrons in leading to further fission. The average time in the water boiler between fissions due to prompt neutrons was found to be 135 ± 20 μsec.

2898

Los Alamos Scientific Lab.
AN ENRICHED HOMOGENEOUS NUCLEAR REACTOR. [nd.] Decl. Jan. 25, 1951. 45p. (AECD-3059; LADC-887)

Lower Power Water Boiler (LOPO). Design considerations, solution composition, precautions in approaching criticality, and calibration measurements on this original version of the water boiler are discussed. After criticality had been reached, the highest power to which LOPO was run during its entire existence was about 50 milliwatts at an average temperature of 39°C. High Power Water Boiler (HYPO). Constructional details, material requirement, safety devices, operational features, flux and power, and steadiness of operation are presented in detail, and suggestions are made for future modifications. With an inlet water temperature of about 8°C and 870 g of U^{235} in the boiler, it is possible to run continuously at 5.5 kw without exceeding a solution temperature of 85°C. 8 figures.

2899

Los Alamos Scientific Lab.
WATERBOILER. C. P. Baker, H. K. Daghlian, G. Friedlander, M. G. Holloway, D. W. Kerst, and R. E. Schreiber. Sept. 4, 1944. Decl. Feb. 21, 1951. 45p. (AECD-3063; LADC-819)

The structural features of the uranyl sulfate water boiler (LOPO) in use at Los Alamos are given in detail with a full account of the safety features. Results of the corrosion tests on stainless steel of which the sphere was made are presented, and the fabrication of the BeO tamper surrounding the sphere is described. The structure and function of the control rod, the safety rod, and their related mechanical systems are explained, and an account is given of the temperature-controlling system. The activity of the boiler was measured as the mass of active material approached criticality; the results are discussed in detail. The control rod was calibrated, and the effect of temperature change was noted. Measurements were also made on the supercritical period. Substituting graphite for BeO as reflector material increased the critical amount; the insertion of U slugs did not improve the effectiveness of graphite reflector greatly. 19 figures. (auth)

2900

Argonne National Lab.
CHEMICAL PROBLEMS IN THE DEVELOPMENT AND OPERATION OF NUCLEAR REACTORS. W. M. Manning. Jan. 15, 1951. Decl. Jan. 30, 1951. 14p. (AECD-3067; ANL-WMM-768)

A few specific problems relating to the processing of nuclear fuel and to reactor construction and operation have

been selected for discussion to indicate the extent to which chemical knowledge is used in the practical exploitation of nuclear fission. Brief remarks on fission-product chemistry are followed by a more detailed study of Pa in a Th-U^{233} cycle. The importance of the ratio of neutrons absorbed in desired reactions to those lost in undesired reactions and by leakage is stressed. Production of Hf-free Zr and measurement of neutron-fission cross sections (using that of Np^{239} as an example) are discussed.

2901

SOME REMARKS ON REGENERATIVE URANIUM REACTORS. Gunnar Randers. In Forsvarets Forskningsinstitutt, Årbok 1947, 1-5. (In Norwegian)

Some considerations are presented on conditions under which a reactor produces as many fissionable nuclei of Pu^{239} as it uses up U^{235} nuclei through fission.

NUCLEAR TRANSFORMATIONS

2902

Argonne National Lab. and Illinois Univ.
THRESHOLD FOR PHOTO-NEUTRON REACTION IN U^{238}. J. R. Huizenga, L. B. Magnusson, P. R. Fields, M. H. Studier, and R. B. Duffield. Jan. 8, 1951. Decl. Feb. 26, 1951. 4p. (AECD-3070; ANL-WMM-769)

X rays produced by the 22-Mev betatron at the University of Illinois were used to measure the threshold for the photoneutron reaction $U^{238}(\gamma,n)U^{237}$. The energy scale was determined relative to the threshold for the 10-min activity from the $Cu^{63}(\gamma,n)Cu^{62}$ reaction, which is taken as 10.9 Mev. The experimental arrangements were similar to those described by McElhinney et al. (Phys. Rev. 75, 542(1949)). The excitation function could be approximated by a parabola, which made it possible to estimate the threshold from a linear extrapolation of the square root of U^{237} yield plotted as a function of x-ray energy. Analysis of the data gives a threshold of 5.97 ± 0.05 Mev for the $U^{238}(\gamma,n)U^{237}$ reaction.

2903

Los Alamos Scientific Lab.
NEUTRON YIELD FOR THE Li + T REACTIONS. R. W. Crews. [nd.] 6p. (AECU-1171; LADC-899)

A preliminary investigation of neutron production from bombardment of natural metallic Li by tritons with energies between 0.25 and 2.10 Mev has been made, using the Los Alamos 2.5-Mev electrostatic accelerator. Neutron yield at 0 deg, expressed as a cross section, is shown. Apparent resonances occur at triton energies of 0.84 and 1.70 Mev. It may be assumed that these peaks indicate virtual states in Be^{10} of 17.91 and 18.51 Mev. Two angular distributions of neutron yields, expressed in terms of differential cross sections, are presented. Numerical integration of the data at 0.728 Mev gives a total cross section ~0.5 barn. An average total cross section ~0.7 barn is obtained for a triton energy range of 0.25 to 2.0 Mev.

2904

Los Alamos Scientific Lab.
THE D-He^4 INTERACTION FOR 10.3-MEV DEUTERONS. J. C. Allred, Darol K. Froman, Alvin M. Hudson, and Louis Rosen. [nd.] 21p. (AECU-1188; LADC-782)

Elastic scattering and disintegration of 10.3-Mev deuterons bombarding He^4 have been studied by means of a multiple-nuclear-plate camera. The reaction $d + He^4 \rightarrow He^4 + p + n - 2.2$ Mev was observed with a total cross section of 0.3 ± 0.1 barn. The protons show a marked tendency to emerge in the forward direction, and there is some, not very strong, evidence for the formation of He^5 as an intermediate product. The differential elastic-scattering cross section was measured at intervals of 2.5 deg in the laboratory system from 12.5 to 140 deg. The shape of this cross-section curve can be inferred from the following approximate values (angles in center-of-mass system and differential cross sections in millibarns per unit solid angle): 29.4 deg, 186; 58.4 deg, 9.7; 97.7 deg, 69; 129.3 deg, 37; 157.4 deg, 82.4. (auth)

2905

Oak Ridge National Lab.
HIGH-VOLTAGE ACCELERATOR PROGRAM, p.56-61 of QUARTERLY PROGRESS REPORT FOR PERIOD ENDING SEPTEMBER 20, 1950; PHYSICS DIVISION. W. M. Good, B. D. Kern, and C. D. Moak. Jan. 8, 1951. 6p. (ORNL-865 (p.56-61))

Reactions of B^{11} + protons are reported. A preliminary study has been made of the particle spectra from these reactions, using an electron collection chamber and differential pulse-height selection. In addition, it has been possible to obtain the yield with voltage of the groups of α's taken separately. For the results given here, the target was elemental boron evaporated to a thickness of about 5 kv onto a water-cooled tungsten backing. The electron collection chamber had a window about 1 cm in diameter, about 3 cm from the target, and at 90 deg to the beam. The window was 30 $\mu g/cm^2$ of Formvar, and aluminum absorbers in front of the window screened out the scattered protons. The α-particle spectrum at a bombarding energy of 182.5 kev is shown. By setting the spectrometer at pulse heights corresponding to the peaks of short-range and long-range groups, yield curves were obtained. The spectrometer consists of a NaI crystal 1 by 1½ in. in diameter, an RCA 5819 photomultiplier tube, and a linear amplifier followed by a differential pulse-height selector. The differential number versus pulse-height curve shows peaks which correspond to three γ rays, and the pulse-height calibration is linear within the present uncertainties of the instrument. Coincidences were obtained between the 12- and 4-Mev γ rays, confirming what seemed certain, viz., that the 12- and 4-Mev γ's take place in succession to the ground state of C^{12}. The 16-Mev γ ray is a direct transition.

2906

Radiation Lab., Univ. of California
FAST PROTONS FROM THE CAPTURE OF π^- MESONS IN PHOTOGRAPHIC EMULSIONS. Frank L. Adelman. Nov. 15, 1950. 49p. (UCRL-1005)

An abstract of this report was indexed as Report UCRL-980 and appeared in its entirety in Nuclear Science Abstracts as NSA 5-702.

2907

Radiation Lab., Univ. of California
ON THE RELATION BETWEEN THE NEUTRON-NEUTRON FORCE AND THE γ RAY SPECTRUM FROM π^- MESON CAPTURE IN DEUTERIUM. K. M. Watson and R. N. Stuart. Nov. 30, 1950. 1p. (UCRL-1028)

The report is reproduced here in its entirety.

The radiative capture of slow π^- mesons in deuterium leads to a final state containing two slow neutrons, causing the γ-ray spectrum to depend sensitively on the nature of the n-n force. (This effect has been noted by Tamor and Marshak, Phys. Rev., in press, and by Brueckner, Serber, and Watson, Phys. Rev., in press.) It is shown that to a good approximation the γ-ray spectrum (near its high-energy limit) is independent of the detailed mechanism of the meson-absorption process and can be expressed directly in terms of the ^1S phase shift, δ, for n-n scattering by means of a multiplicative factor, $\sin^2 \delta$. The fine details of the spectrum depend on the deuteron wave function essentially outside the range of the n-p force and on the details of the absorption in hydrogen (for which an appeal is made to experimental results on the inverse process of photomeson production). The analysis leads to a means of deducing the effective range and scattering length for the singlet n-n potential.

2908

Radiation Lab., Univ. of California
RELATIVE PHOTO-NEUTRON YIELDS FROM THE 330-MEV BREMSSTRAHLUNG. W. M. Jarmie, L. W. Jones, and K. M. Terwilliger. Jan. 12, 1951. 22p. (UCRL-1083)

An abstract of this report was indexed as Report UCRL-989 and appeared in its entirety in Nuclear Science Abstracts as NSA 5-2582.

2909

Radiation Lab., Univ. of California
ON THE γ-RAY SPECTRUM RESULTING FROM THE ABSORPTION OF π^- MESONS IN DEUTERIUM. Kenneth M. Watson and Richard N. Stuart. Jan. 17, 1951. 28p. (UCRL-1086)

The γ-ray spectrum resulting from the reaction $\pi^- + D \rightarrow 2n + \gamma$ has been shown to depend strongly on the nature of the n-n interaction and has been calculated for several values of the n-n scattering length. A comparison of the theoretical cross section with preliminary experiments by Aamodt, Panofsky, and Phillips (Phys. Rev., in press) indicates: (1) an upper limit of approximately 200 kev can be put on the binding energy of the di-neutron, and (2) photomeson production involves an interaction with the nucleon spin. (auth)

2910

THE ANGULAR DISTRIBUTION OF THE NEUTRONS PRODUCED IN THE PHOTO-DISINTEGRATION OF THE DEUTERON BY THE 2.51-MEV GAMMA-RAYS OF Ga^{72}. G. R. Bishop, H. Halban, P. F. D. Shaw, and Richard Wilson. Phys. Rev. 81, 219-22(1951) Jan. 15.

The angular distribution of the neutrons resulting from the photodisintegration of the deuteron by the 2.51-Mev γ rays of Ga^{72} has been studied. The ratio of the magnetic to the electric cross section has been determined to be 0.61 ± 0.04. A discussion is given of the present status of the problem. (auth)

2911

ANGULAR DISTRIBUTIONS OF (d,p) REACTIONS USING 14-MEV DEUTERONS. H. E. Gove. Phys. Rev. 81, 364-73 (1951) Feb. 1.

The angular distribution of (d,p) reactions for a series of target elements, using 14-Mev deuterons, has been investigated. The targets chosen were thin foils of C, Al, Ni, Ag, Ta, Au, and Bi. These were bombarded with deuterons from the MIT cyclotron in the center of a large scattering chamber shielded from the cyclotron by 4 ft of concrete. The emitted protons were detected in a triple proportional counter which could be set at any angle from 15 to 135 deg to to the beam. In all cases the measured intensity of protons per unit solid angle is found to be greater in the forward direction. The ratio of the area under the distributions from 20 to 90 deg to that between 90 and 140 deg varies from 1.6 to 13. For a given element this ratio increases with proton energy. In addition, for C and Al, in which individual groups can be resolved, the intensity of protons in a given group, in some cases, exhibits maxima at various angles. In the three elements of highest atomic number, the intensity rises from back angles to a maximum at some forward angle and then drops off toward 0 deg. The position of this "turnover" angle appears to increase slowly with atomic number. The general features of the distributions appear to be explainable on a stripping picture rather than that of a compound nucleus. (auth)

2912

AN ATTEMPT TO FIND EVIDENCE FOR A Fe(n,α) REACTION CAUSED BY SLOW NEUTRONS. Henriette Faraggi. Compt. rend. 231, 1475-6(1950) Dec. 18. (In French)

By exposing Ilford D1 emulsions impregnated with ammoniacal Fe citrate to a flux of 2.34×10^{11} neutrons/cm^2 from the Chatillon pile and examining the resulting tracks with a microscope, the author shows that the cross section for the Fe(n,α) reaction is less than 6×10^{-29} cm^2. The observation of Hanni and Rossel (Helv. Phys. Acta 23, 513(1950)) of α particles corresponding to a cross section of 4×10^{-26} cm^2 for this reaction is attributed tentatively to Po contamination of their impregnating solution.

2913

A CLOUD-CHAMBER STUDY OF NUCLEAR INTERACTIONS IN LEAD AND ALUMINUM; PART I. B. P. Gregory and J. H. Tinlot. Phys. Rev. 81, 667-75(1951) Mar. 1.

The nuclear interactions of cosmic-ray particles in Pb and Al have been studied in two cloud-chamber experiments. The results of the first experiment, which yields an unbiased sample of interactions of protons, are used to discuss the relative and absolute cross sections in the two materials and the absolute intensity and energy spectrum of the incident protons. The second experiment was designed to select interactions of neutrons in which at least one penetrating ionizing particle was produced. The types of interactions observed are in this case intimately related to the probability of triggering the cloud chamber. This problem

is discussed in some detail, preparatory to more detailed analysis of this experiment in part II of this paper (see following abstract). (auth)

2914

A CLOUD-CHAMBER STUDY OF NUCLEAR INTERACTIONS IN LEAD AND ALUMINUM; PART II. B. P. Gregory and J. H. Tinlot. Phys. Rev. 81, 675-82(1951) Mar. 1.

The results of a previous cloud-chamber experiment described in Part I of this paper (see preceding abstract) are used to discuss some properties of the particles produced in nuclear interactions. Evidence is presented showing that the electronic showers produced in nuclear interactions are photon-initiated. Upper limits on the proportion of directly produced electrons are found to be 20% in interactions in Al and 41% in Pb. The possibility that the photons are decay products of neutral π mesons is strongly indicated, although no definite proof can be given. It is shown that the mean free paths for nuclear interaction of secondary penetrating particles are 172 ± 30 g/cm^2 in Pb and 164 ± 50 g/cm^2 in Al. Assuming that the penetrating particles consist of equal numbers of π mesons and protons, one obtains an upper limit of 250 g/cm^2 for the mean free path for interaction of π mesons in Pb. (auth)

2915

THE EXISTENCE OF DIFFERENT CAPTURE LEVELS IN THE FORMATION OF NUCLEAR ISOMERS BY SLOW NEUTRON IRRADIATION. P. C. Capron and A. J. Verhoeve-Stokkink. Phys. Rev. 81, 336-9(1951) Feb. 1.

Experiments have been performed on the formation of Br and Rh isomers, by thermal as well as resonance neutrons, in order to study capture levels. With slow neutrons of variable energies obtained from a Ra-Be source in a slowing-down medium of paraffin, studies were made of (a) the relative formation of the isomeric pairs as a function of the distance from the source and (b) the migration distances for each isomer. The experimental results show that, for Br isomers produced by resonance neutrons as well as for Rh isomers produced by resonance and C neutrons, the ratio of the activities of the fundamental state to the metastable state is a function of the distance from the source. Moreover, at each point this ratio is different for resonance and for C neutrons. The migration distances, corresponding to each of the isomers formed by resonance neutrons on Br or by C neutrons on Rh, are found to be different. This leads to the assumption of the existence of more than one capture level in the formation of the Br and Rh isomers. It may be suggested that for Rh the resonance levels extend within the region defined by the C neutrons. (auth)

2916

HAMMER TRACKS IN NEUTRON AND PROTON INDUCED STARS. E. W. Titterton. Phil. Mag. (7) 42, 113-17(1951) Jan. (Correspondence)

Hammer tracks observed in the present experiment, whether they are due to Li^8 or B^8, almost certainly result from the breakup of light elements since the emission of such fragments from Ag or Br nuclei at these excitation energies would be an improbable process due to the impenetrability of the Coulomb barrier. The prong spectrum and angular distribution for the 21 stars are compared with the equivalent distributions obtained in the case of neutron-induced stars without hammer tracks. The comparison is compatible with the view that the events are due to the disintegration of the light elements in the emulsion. If this view is accepted, application of the principles of charge and, to a lesser degree, momentum conservation then allows conclusions to be drawn about the reactions responsible for these stars. Results suggest that Li^8 is a much more likely residual nucleus than B^8, and the cross section for Li^8 production, averaged over C, N, and O atoms in emulsion, is found to be 0.6 ± 0.2 mb. The energy spectrum of the Li^8 nuclei is indicated, and the energy release in the breakup of the resulting Be^8 nuclei is shown by a histogram. The histogram is in agreement, within the statistics, with that found for Be^8 resulting from the reaction $Be^9(\gamma,p)Li^8$.

2917

NEUTRON–GAMMA RAY ANGULAR CORRELATION IN THE DISINTEGRATION OF Li^7 BY DEUTERONS. Jacques Thirion and Théo Muller. Compt. rend. 232, 1093-4(1951) Mar. 12. (In French)

The highly anisotropic angular distribution of the neutrons corresponding to the 4.9-Mev excited state of the Be^8 formed in the bombardment of Li with 720-kev deuterons has been correlated with the direction of the corresponding γ rays. The correlation curve has the form $1 - 0.45 \cos^2 \theta$.

2918

NUCLEAR REACTIONS AND ARTIFICIAL RADIOACTIVITY. H. Maier-Leibnitz. In FIAT Review of German Science in 1939-1946, Wiesbaden, Dieterich'sche Verlagsbuchhandlung (vol. 13, part 1, paper 3.6, p.141-53). (In German)

A general survey is made of the experimental work done in Germany during World War II in the field of nuclear reactions with the exception of uranium fission and the formation of isomers, the latter subjects being discussed elsewhere in the same publication (papers 4 and 3.7). Thirty-three references are given covering elements of all weights, including the rare earths.

2919

Laboratory for Nuclear Science and Engineering, Mass. Inst. of Tech.
NUCLEAR SHIELDING STUDIES; IX. THE INTERACTION OF FAST NEUTRONS WITH NUCLEI; TECHNICAL REPORT NO. 45. H. B. Willard, W. M. Preston, and Clark Goodman. Sept. 27, 1950. 41p. (NP-1948)

The theory for such interactions as elastic and inelastic scattering and charge particle production was developed on the basis of an ideal experimental setup. Experiments were performed using an electrostatic accelerator in conjunction with the $Li^7(p,n)Be^7$ reaction to produce monoenergetic neutrons from 0.1 to 2.4 Mev. The sensitivity of a small $B^{10}F_3$ counter revealed four resonances at 0.595-, 1.286-, 1.646-, and 2.041-Mev neutron energies which were attributed to the $F^{19}(n,\alpha)N^{16}$ reaction. The total cross sections measured were those of B^{10}, B^{11}, C, F^{19}, Fe, and Pb. B^{10} (resolution 25 kev) exhibits no resonances. B^{11} (resolution 25 kev) has an elastic-scattering resonance at 1.245 Mev ($l = 1$, $J = 2$) and another resonance at 1.771 Mev ($l = 1$, or $J = 3$). Carbon (resolution 25 kev) used as a check is a smooth curve. F^{19} (resolution 25 kev) has an elastic-scatter-

ing resonance at 0.952 Mev (l = 1, J = 2) and resonances due to α-particle emission and elastic scattering at 0.595, 1.283, 1.651, and 2.043 Mev. Fe (resolution 5 kev) has an elastic-scattering resonance at 0.74 Mev (l = 1, J = ½) due to Fe^{56} and another resonance at 1.03 Mev (l = 0, J = ½). Lead (resolution 5 kev) has three elastic-scattering resonances, 0.71 (l = 1, J = ½), 0.98, and 1.35 Mev. Inelastic scattering in Pb was measured with a hollow conical-shell geometry and revealed probable levels at 0.7 and 1.65 Mev.

2920

RADIOACTIVITY IN NUCLEAR REACTIONS; II. A. H. W. Aten, Jr. Chem. Weekblad 47, 113-18(1951) Feb. 24. (In Dutch)

The fact that the energy involved in nuclear reactions is of the order of 10^6 ev is explained by considering the influence of the size of the nucleus on the electrostatic forces between protons. In the cyclotron, nuclear reactions are mainly induced by deuterons; different processes are discussed. In the U pile, radioactive materials are obtained both by neutron capture and by fission of U nuclei. As a rule the (d,p) and neutron-capture reactions do not provide carrier-free preparations, but cases where the Szilard-Chalmers reaction can be applied or where the active isotope is formed by the decay of another radioactive element are exceptions. As a rule reactions in which the ratio Z/A is decreased lead to products which are β^--active, whereas processes in which this ratio is increased give mainly isotopes which show positron or electron-capture activities. (auth)

2921

RELATIVE ADVANTAGES OF (d,p) AND (n,γ) REACTIONS IN THE PRODUCTION OF RADIOHALOGENS IN A CYCLOTRON OF MODERATE ENERGY. Einar Saeland. In Forsvarets Forskningsinstitutt, Årbok 1947, 269-74. (In French)

A comparative study was made of the yields of Cl^{38}, $Br^{80,82}$, and I^{128} obtained both by bombarding Li halogenides with 6.7-Mev deuterons in a cyclotron and by irradiating ethyl and propyl halogenides with slow neutrons. In (d,p) reactions the yields, measured as relative and specific activities, decreased in the order Cl, Br, and I, a result which is in accordance with the known data on potential barriers of those nuclei. For the (n,γ) process a reverse order was observed in activities extracted with H_2S from the irradiated substances; the remaining nonextractable activities were very strong in the case of Br.

2922

THE TRANSFORMATION OF BORON THROUGH THE ACTION OF SLOW NEUTRONS. H. Fränz and H. Westmeyer. Z. Physik 128, 617-28(1950) Dec. 7. (In German)

Using a proportional amplifier, the energy of the He + Li nucleus, formed during the process $B^{10}(n,\alpha)Li^7$, was measured in an ionization chamber filled with a mixture of A with a few per cent of BF_3 or $B(OCH_3)_3$. For calibration purposes, a range-ionization curve, plotted for single α rays of 0.5 to 3 Mev, was confronted with the range-energy curves of Holloway et al. (Phys. Rev. 54, 18(1938)) and of Jesse et al. (Phys. Rev. 78, 1(1950)). The reaction energies found are 2.35 ± 0.10 and 2.85 ± 0.10 Mev for processes ending in the excited and the ground state of Li, respectively. The relationship between these energy values and the corresponding ranges is discussed in the light of the information furnished by the general energy-range curve for α rays. (auth)

PARTICLE ACCELERATORS

2923

Brookhaven National Lab.
FORCED BETATRON OSCILLATION IN A SYNCHROTRON WITH STRAIGHT SECTIONS. Nelson M. Blachman. [nd.] 8p. (AECU-1111)

The effect of azimuthal variation in the height of the magnetic median plane on the vertical oscillations of a particle in a synchrotron with four straight sections is studied, particularly in the neighborhood of resonance between the frequency of these oscillations and the frequency of revolution. It is found that Fourier analysis, which is needed in the case of a circular magnet, is replaced by analysis using modified sine and cosine functions. This investigation also applies to the effect on the radial betatron oscillations of azimuthal variation in the equilibrium radius. (auth)

2924

Oak Ridge National Lab.
HEAVY POSITIVE ION BOMBARDMENT STUDIES, p.84-6 of QUARTERLY PROGRESS REPORT FOR PERIOD ENDING SEPTEMBER 20, 1950; PHYSICS DIVISION. G. E. Evans and J. W. Schwartz. Jan. 8, 1951. 3p. (ORNL-865(p.84-6))

Work on the preliminary design, construction, and bench-testing of a positive-ion source for the Cockcroft-Walton and Van de Graaff generators is essentially complete. The present source has produced a total positive-ion current of 0.8 ma, using solid sodium chloride as a source of sodium ions. The various components of the ion source are shown schematically. The outer casing is of pyrex, employing commercially available 5-in. flanges grooved for "O" ring seals. The sodium chloride charge is placed within the stainless-steel furnace, and the NaCl vapor produced escapes through a 4-mm hole in the bottom of the furnace. The furnace is maintained at a potential of about 2000 volts positive with respect to the filament and is heated by electron bombardment. The electron beam also serves to ionize the NaCl gas in the region between the filament and furnace. To study the focusing characteristics of the lens system, the standard electrolytic tank technique was employed. It was determined that, for a suitable geometry for the lenses, focusing could be obtained with the bottom aperture lens at 0 volts, the cylinder lens at 8000 volts, and the furnace at 10,000 volts. A power supply was then constructed giving variable voltages of this order of magnitude. A schematic diagram of the power supply is also shown. The power supply allowed the cylinder lens to operate at a maximum of 23 kv above ground, but arcing in the ion source reduced the maximum usable voltage to less than 8 kv.

2925

Radiation Lab., Univ. of California
NEGATIVE IONS AND CHARGE NEUTRALIZATION IN THE

CYCLOTRON. E. J. Lofgren. Nov. 13, 1950. 12p. (UCRL-1006)

Evidence is given for the presence of negative hydrogen ions in the synchrocyclotron. They are lost by charge neutralization before they reach an energy of about 3 Mev. Protons have been made to circulate in the cyclotron without acceleration after they have reached an energy of 5 to 22 Mev and are found to be lost with a half-life of ½ to 2 sec. (auth)

2926

Great Britian
HELIX AS LINEAR PROTON ACCELERATOR. W. Walkinshaw and K. Wyllie. [nd.] 14p. (Maths. Memo/57/WW)

A helix is proposed as a linear proton accelerator for energies between 5 and 20 Mev. The optimum frequency is probably between 60 and 300 Mc/sec depending on the output energy required. Curves are given for the accelerating field per unit power, the attenuation, the group velocity, and the shunt impedance. It is estimated that the length of a 20-Mev accelerator is between 2 and 6 m/Mw power. (auth)

2927

INVESTIGATIONS ON THE CAPTURING OF ELECTRONS IN A 30-MEV BETATRON. R. Wideröe. J. Applied Phys. 22, 362-3(1951) Mar. (Letter to the editor)

Experimental work with a 30-Mev betatron indicates that the vacuum chamber of the betatron is completely filled with electrons. An electrode was inserted in the vacuum chamber at a remote section where at no time could it be reached by direct electrons from the gun. When electrons were injected into the chamber, relatively strong currents were observed through this electrode. A capture process independent of space charge was also used, which consisted in superimposing over the guide field a rapidly changing magnetic field. By using a short injector-voltage pulse of only a few microseconds duration, it was possible to trap the electrons. In this way the γ-ray yield was nearly doubled.

2928

AN ORBIT-BENDER TO ASSIST INJECTION INTO BETATRONS. Leverett Davis, Jr. Rev. Sci. Instruments 21, 971-2(1950) Dec.

It is suggested that the fraction of the betatron or synchrotron beam that is lost by striking the injector might be decreased by a suitable transient bending of the steady-state orbit during injection. (auth)

2929

PRODUCTION OF HIGH CURRENT HIGH ENERGY ELECTRON PULSES OF SHORT DURATION. G. W. Clark and L. B. Snoddy. Virginia J. Sci. (new series) 1, 338(1950) Sept.

The article is reproduced here in its entirety.

A single reentrant resonant cavity operating at approximately 405 Mc has been successfully used to produce high-current high-energy electron pulses of short duration. The cavity, which is essentially two quarter-wave transmission lines back to back, is driven by a Western Electric 7C22 pulse-operated twin-triode oscillator. The 7C22 oscillator is supplied from a conventional pulsing circuit operating at 18,000 to 22,000 volts with a pulse length of 5 μsec. After approximately 4 μsec from the beginning of the square pulse, a quenched vacuum spark of less than 10^{-7} sec duration is produced on the surface of one of the reentrant electrodes inside the cavity by a special transmission-line arrangement. This spark supplies the electrons that are accelerated across the cavity gap. The duration of the electron pulse depends upon the transmission line to the vacuum-spark gap and the energy stored in the cavity at the time of the spark breakdown. At present it is possible to accelerate as many as 2×10^{12} electrons with energies greater than 40 kev in a single pulse lasting less than 10^{-7} sec. The energy distribution and the time length of the pulse are now being accurately determined as a function of supply-circuit constants.

RADIATION ABSORPTION AND SCATTERING

2930

Los Alamos Scientific Lab.
THE SCATTERING OF 10.4-MEV DEUTERONS BY HYDROGEN. Louis Rosen and J. C. Allred. [nd.] 26p. (AECU-1173; LADC-905)

The D-P elastic-scattering cross section has been measured in the angular region 30- to 160-deg center of mass by means of a nuclear multiple-photographic-plate camera. Thin H_2 gas targets were bombarded by deuterons from the Los Alamos cyclotron, the incident deuteron energy at the center of the reaction volume being 10.4 Mev. Values of the scattering differential cross section are given within an absolute standard error of ±3% in the range 40- to 140-deg center of mass and to ±5% in the remainder of the angular range observed. Results of this measurement are in good agreement with previously reported data. The estimated total nuclear cross section, 1.5×10^{-24} cm^2, is essentially that observed for the n-d collision at the same center-of-mass energy. A least-squares fit indicates S-, P-, and D-wave interactions to be present at this energy. (auth)

2931

Radiation Lab., Univ. of California
ON THE HARD SPHERE MODEL OF THE NUCLEON. Robert Jastrow. Dec. 28, 1950. 7p. (UCRL-1069)

It has been suggested that the evidence from P-P scattering experiments at 340 Mev for large momentum transfers in nucleon-nucleon collisions may be explained by the assumption of a strong short-range repulsion between nucleons. The experiments at intermediate energies are of special interest because the assumption of a repulsion in the nucleon-nucleon interaction results in the appearance of a pronounced minimum in the singlet cross section at energies in the neighborhood of 170 Mev, as a result of interference between the repulsion and the surrounding attractive well. This minimum is partly masked by a maximum in the tensor contribution to the complete cross section at corresponding energies, but its effect becomes appreciable for sufficiently large radii of repulsion. Values of the P-P cross section at 90 deg for energies between 100 and 340 Mev are compared with calculations in which the repulsion is represented by a hard sphere, using radii of 0.50 and

0.60×10^{-13} cm. It may be concluded that a radius greater than 0.60×10^{-13} cm would lead to a minimum in the P-P cross section incompatible with present experimental values. The angular dependence of the P-P cross section at intermediate energies has also been measured recently and is compared at 100 and 250 Mev with curves calculated on the assumption of a hard-sphere repulsion of radius 0.60×10^{-13} cm. Revised values at 340 Mev are shown on a graph of the P-P cross section calculated from the same model.

2932

CONCERNING TWO NOTES OF EHRENHAFT AND HERZOG. IS A UNIFORM MAGNETIC FIELD CAPABLE OF ACCELERATING RADIATION EMITTED BY RaE? Eugène Cotton, Pierre Tauzin, and Belling Tsaï. Compt. rend. 232, 44-6 (1951) Jan. 3. (In French)

Ehrenhaft and Herzog (Compt. rend. 227, 550(1948); ibid. 227, 626(1948)) have described experiments in which a uniform magnetic field apparently favored the passage through an Al absorber of the radiation of RaE (Bi^{210}). These authors believed that the radiation contained unit magnetic poles. The present paper describes Al absorption experiments with photographic emulsion as detecting instrument, the results of which indicate that such observations are due to bremsstrahlung.

2933

DECELERATION OF NEUTRONS. W. Ramm. In FIAT Review of German Science in 1939-1946, Wiesbaden, Dieterich'sche Verlagsbuchhandlung (vol. 13, part 1, paper 3.4, p.129-33). (In German)

In a review of work done in Germany during World War II on the slowing down of neutrons, discussion is presented concerning chiefly theoretical investigations by Bothe (Z. Physik 122, 648(1944)), Flügge (Physik. Z. 44, 445(1943)), and Lyons (Naturwissenschaften 30, 582(1942)) and experiments with carbon and heavy water by Jensen (Z. Physik 122, 756(1944)) and K. Wirtz (unpublished).

2934

DIFFUSION OF THERMAL NEUTRONS IN ABSORBING SUBSTANCES. W. Ramm. In FIAT Review of German Science in 1939-1946, Wiesbaden, Dieterich'sche Verlagsbuchhandlung (vol. 13, part 1, paper 3.5, p.133-9). (In German)

During World War II the theory of the diffusion of thermal neutrons ending in their capture by nuclei was investigated in Germany by Bothe (Z. Physik 118, 401(1941); ibid. 119, 493(1942)) in a way differing from that followed by American writers (Halpern et al., Phys. Rev. 53, 173(1938); Uehling, ibid. 59, 136(1941)). The experimental verification of the theory was done by Bothe and coworkers (Z. Physik 122, 749, 769(1944)) according to a procedure suggested by Döpel and Heisenberg (unpublished report). Other experimental works connected with Bothe's theory were those of Gehlen (Z. Physik 121, 268(1943)), Volz (Z. Physik 121, 201(1943)), Ramm (Naturwissenschaften 30, 755(1942)), and Raether (Z. Naturforsch. 1, 367(1946)). Haxel et al. (Z. Physik 120, 493(1943)) studied the absorption of neutrons in aqueous solutions.

2935

LIST OF MEASURED VALUES OF EFFECTIVE CROSS SECTIONS FOR THERMAL NEUTRONS. S. Flügge. In FIAT Review of German Science in 1939-1946, Wiesbaden, Dieterich'sche Verlagsbuchhandlung (vol. 13, part 1, p.139-41). (In German)

Supplementing information on German work during the last war on the absorption of thermal neutrons as given by Ramm (FIAT Review of German Science in 1939-1946, vol. 13, part 1, p.133), numerical data on absorption cross sections are presented; among them are those obtained by Bomke et al. (Z. Physik 120, 56(1943)) and by Riezler (Ann. Physik 41, 476(1942)) for rare earths.

2936

NEUTRON-DEUTERON SCATTERING AT HIGH ENERGY. R. L. Gluckstern and H. A. Bethe. Phys. Rev. 81, 761-81 (1951) Mar. 1.

The neutron-deuteron total scattering cross section at high energy has been calculated by expressing it as a sum over two-particle states over a wide range of energy. A sum rule was then applied to give the total cross section, that is, the elastic and inelastic cross sections. The calculations were performed with a Serber-type exchange force for the neutron-proton force in agreement with present neutron-proton-scattering data and a neutron-neutron force of arbitrary depth and exchange character. The neutron-neutron well depth was then determined for an ordinary Serber-type pure exchange force between the two neutrons by making use of the experimental neutron-deuteron total cross section. The neutron-deuteron elastic scattering was then calculated for the three different types of neutron-neutron exchange and was found to agree best with the experimental value for the Serber-type exchange (no force in odd states). The cross section for production of low-energy protons was also calculated and confirmed the Serber-type exchange force between the two neutrons when compared with the experimental value. Finally, a qualitative discussion of the angular and energy distribution of the low- and high-energy protons was given. (auth)

2937

Columbia Univ.
NEUTRON SCATTERING EXPERIMENTS, sect. II of PROGRESS REPORT; NUCLEAR PHYSICS LABORATORIES. J. R. Dunning, Director. Sept. 30, 1950. 2p. (CUD-61 (sect. II))

The previously reported discrepancy in the calibration curve has been resolved, and a theoretical Breit-Wigner one-level formula has been fitted to the experimental data for $(\sigma_s/\sigma_t)_{Au}$ versus neutron time-of-flight. The combination of the scattering measurements with additional experimental data has permitted the evaluation of all the level parameters for the 4.87-ev Au resonance to within greater than 10% accuracy. Several materials have been examined with the forward-scattering apparatus, but the absolute calibration of the apparatus remains to be done. MnO and MnF_2 have been investigated for paramagnetic scattering and are being compared with theory. Polythene (incoherent scattering) and Teflon (coherent scattering) have been investigated, the latter showing a typical liquid scattering pattern. (auth)

2938

A NEW TYPE OF X-RAY SCATTERING. K. Das Gupta. Nature 167, 313-14(1951) Feb. 24. (Letter to the editor)

A brief note is presented of a suggested new type of x-ray scattering. This scattering has been achieved by the modification of the characteristic soft-x-ray beam of the constituents of a pure insulator by partial absorption in the broad Brillouin zones of the lattice of the same insulator, and the modification by some suitable element introduced in traces into the lattice of a pure insulator.

2939

ON THE THEORY OF THE ANOMALOUS SCATTERING OF α PARTICLES BY ZERO-SPIN NUCLEI. Hans Marschall. Z. Physik 128, 635-56(1950) Dec. 7. (In German)

A theory of anomalous scattering of α particles by zero-spin nuclei is presented in which it is assumed that partial waves representing the α-particle beam cannot, in general, penetrate the nucleus. Only an α particle of definite energy, corresponding to a definite angular momentum, is capable of forming a quasi-stable compound nucleus, with a resulting resonance effect and a wave function of nonzero amplitude. No potential for the nucleus' interior is introduced, the part played by the nucleus being described by a single parameter characterizing the behavior of the wave on the surface of the nucleus. The approximate method of Wentzel-Kramers-Brillouin is used for the derivation of the wave functions. Both the nonabsorbed waves and the resonance one are responsible for the anomalous scattering effect. The contribution of each of these factors is evaluated for the case of O^{16} nuclei, and it is found that in the region below the Gamow summit potential the resonance effect usually predominates, but above that summit both effects can be of equal intensity. (auth)

2940

ON THE THEORY OF SCATTERING OF PARTICLES OF SPIN $\hbar/2$. Gérard Petiau. Compt. rend. 231, 825-7(1950) Oct. 23. (In French)

The scattering cross sections of $\hbar/2$-spin particles coupled by a meson field of scalar, pseudoscalar, or vector type are calculated.

2941

SCATTERING AND ABSORPTION OF GAMMA-RAYS. M. S. Plesset and S. T. Cohen. J. Applied Phys. 22, 350-7 (1951) Mar.

A formulation is presented of the scattering and absorption of γ rays in various materials. The range of γ-ray energies considered is from 1 to 10 mc^2. Results are given for the transmission of γ rays through air and Pb. (auth)

2942

RAND Corp.
TRANSMISSION OF GAMMA RAYS THROUGH LARGE THICKNESSES OF HEAVY MATERIALS. Glenn H. Peebles and Milton S. Plesset. June 9, 1950. 40p. (P-155(RAND))

A study has been made of the feasibility of accurate numerical determinations of the transmission of γ rays through large thicknesses of materials. The first procedure investigated consists in regarding the total probability of photon transmission, N_t, as the sum of the probabilities N_n, where N_n is the probability of photon transmission with exactly n scatterings. The total expected transmitted energy, E_t, is similarly considered to be given by ΣE_n. A numerical calculation of N_n and E_n has been made for n = 0, 1, 2, 3 for a slab of U 20 cm thick upon which photons are incident normally with energy α = 10 mc^2. The maximum value of N_n/N_0 occurs at n = 2 and of E_n/E_0 at n = 1. These calculations are also adapted to a slab of Pb 35 cm thick. Consideration has been given to the behavior of N_n and E_n for large n, and estimates are thereby made for N_t and E_t. The second procedure consists in deriving the transmission through a thick slab from a succession of transmissions through thin slabs. The transformation of an incident photon distribution into the distribution transmitted through a thin slab is conveniently expressed as a matrix, and the total transmission is then given by the iteration of the matrix on the successive transmitted distributions. Numerical results obtained by this procedure for particular incident photon distributions are presented. (auth)

RADIATION EFFECTS

2943

Oak Ridge National Lab.
PHASE TRANSITION ON NEUTRON BOMBARDMENT, p.77 of QUARTERLY PROGRESS REPORT FOR PERIOD ENDING SEPTEMBER 20, 1950; PHYSICS DIVISION. M. A. Bredig. Jan. 8, 1951. 1p. (ORNL-865(p.77))

One sample of PbO consisting of approximately 1 g of the yellow form and another sample respresenting the red form were exposed for one week in a torpedo hole of the X-10 graphite reactor. X-ray-diffraction patterns made before and after irradiation did not reveal any changes in phase composition.

2944

Oak Ridge National Lab.
SEMICONDUCTOR BOMBARDMENT RESEARCH, p.87-95 of QUARTERLY PROGRESS REPORT FOR PERIOD ENDING SEPTEMBER 20, 1950; PHYSICS DIVISION. J. W. Cleland, K. Lark-Horovitz, J. H. Crawford, Jr., J. C. Pigg, and F. W. Young. Jan. 8, 1951. 9p. (ORNL-865(p.87-95))

Cu_2O plates bombarded in a high fast-flux region of the X-10 pile show a conductance behavior similar in many respects to that exhibited by Ge. Experiments have been carried out to investigate this behavior in greater detail. Two low-resistivity (~500 ohm-cm) polycrystalline Cu_2O plates were prepared from plates of very high resistance (~10^5 ohm-cm) by annealing in air for 24 hr at ~950°C and quenching in air to room temperature. These were bombarded in a water-cooled experimental hole in a high fast-flux region. During the first 24 hr of bombardment the conductance decreased more than two orders of magnitude. A linear graph of conductance versus bombardment time at constant pile power for one sample is shown. The results of bombardment studies on several commercial rectifier units have been reported previously. These units showed no reversal of rectification direction and no exact ohmic character even after 12 days of bombardment. One of these units was followed until lead insulation broke down. Complete current-voltage characteristics were taken periodically during the

exposure. A graph of the current at 1 and at 0.1 volt in the forward and back directions as a function of bombardment time is shown. It is interesting to note that after six days of bombardment the unit became almost ohmic at 1 volt, while at 0.1 volt there is some evidence of a reversal of the direction of rectification. A high-resistivity N-type Ge sample was bombarded for short periods of time in the pneumatic tube. When activity had decayed sufficiently, the sample was annealed in a vacuum (10^{-5} mm Hg) for 24 hr at 450°C to remove any effects due to fast-neutron damage. After this treatment the Hall constant and resistivity were measured as a function of temperature. The region around the transition point, the quasi-intrinsic point, was carefully studied; data concerning this region were reported in the last quarterly report (ORNL-782, p.75). Subsequent bombardments have carried the material into the P-type range. The results after conversion are shown. The variation of the concentration of current carriers as a function of irradiation time is shown. Preliminary experiments on the rate of annealing of lattice damage produced in Ge by fast neutrons are underway. One Ge sample was bombarded to the minimum conductivity at dry-ice temperature and stored at this temperature to minimize annealing. After the activity of the sample and holder had decayed to a safe level, the conductivity was followed as a function of time at a constant temperature of 30.2 ± 0.1°C. An increase in conductivity with time was observed.

2945

Oak Ridge National Lab.
BONDED WIRE RESISTANCE STRAIN GAGES, p.98-106 of QUARTERLY PROGRESS REPORT FOR PERIOD ENDING SEPTEMBER 20, 1950; PHYSICS DIVISION. M. R. Goodman. Jan. 8, 1951. 9p. (ORNL-865(p.98-106))

Specimens of annealed copper, 2S aluminum, and Nilvar, 6 by ½ in. diameter, were inserted in the pile in a water-cooled neutron converter hole and maintained at 34°C. Radiation-damage effects and dimensional changes were observed by means of special bakelite-bonded 100-ohm SR-4 gauges that were cemented to the specimens. The specimens and gauges were irradiated for an nvt of 3.0×10^{18} fast neutrons/cm². Data were taken, and graphs of strain versus nvt and strain versus time were plotted. The resulting curves are shown. The curves appear to be a combination of exponential change, straight lines, and erratic behavior. For Cu the total change during irradiation was about -500×10^{-6} in./in. strain. The change for 2S aluminum was about -350×10^{-6} in./in. strain, and for Nilvar it was about -290×10^{-6} in./in. strain. All changes indicated that a concentration had taken place.

2946

Oak Ridge National Lab.
EFFECT OF PILE RADIATION ON PERFORMANCE OF ELECTRICAL LEADS, p.106-7 of QUARTERLY PROGRESS REPORT FOR PERIOD ENDING SEPTEMBER 20, 1950; PHYSICS DIVISION. J. C. Pigg. Jan. 8, 1951. 2p. (ORNL-865(p.106-7))

Measurements of lead-insulation resistance for a number of commercial specimens of lead wire were made during prolonged exposure. The conditions of the experiment approximate the most severe conditions encountered in the usual in-pile measurements of electrical resistance in the X-10 reactor. The specimens tested, chosen so as to be representative of most of the commercial types usually encountered, were (1) unbonded Ceroc, (2) Formex, (3) nylon braid with fiber filler on No. 22 Belden hookup wire, (4) polyethylene high voltage, (5) shielded 2S-aluminum wire with polyethylene insulation, and (6) enameled-glass braid on Leeds and Northrup duplex copper-constantan thermocouple wire. The results of the experiment are summarized.

RADIOACTIVITY

2947

Brookhaven National Lab.
HEAT PRODUCTION IN POTASSIUM. David E. Alburger. Dec. 26, 1950. 2p. (AECU-1113)

The report is reproduced here in its entirety.

Recent determinations of the decay constants, γ-ray and β-ray energies, and shape of the β-ray spectrum of K^{40} now permit a more precise evaluation of the rate of heat production in potassium. Experiments of Sawyer and Wiedenbeck (Phys. Rev. 79, 490(1950)) have shown that 28.3 ± 1.0 β rays and 3.6 ± 0.3 γ rays are emitted per gram of K per second. The γ ray occurs in the K-capture branch and has an energy of 1.47 ± 0.01 Mev, an average value taken from the measurements of Bell and Cassidy (Phys. Rev. 79, 173(1950)), Pringle, Standil, and Roulston (Phys. Rev. 77, 841(1950)), and Hofstadter and McIntyre (Phys. Rev. 80, 631(1950)). The predominant heat energy occurs in the β branch, and estimates thus depend strongly on the characteristics of the β-ray spectrum. A calculation of the mean β-ray energy of K^{40} has been made based on the work of Bell, Weaver, and Cassidy (Phys. Rev. 77, 399(1950)), Alburger (Phys. Rev. 78, 629(1950)), and Feldman and Wu (Bull. Am. Phys. Soc. 25, 5, 10(1950)). Their values for the end-point energy have a weighted mean of 1.34 ± 0.02 Mev, and all three groups find that the shape of the spectrum agrees with the third-forbidden correction factor above 500 to 700 kev. Since the deviations below 500 kev are attributed to source-thickness effects, it is assumed here that the spectrum has the third-forbidden shape over the entire range of energies. The idealized momentum plot for a third-forbidden-type β emitter with end point at 1.34 Mev was constructed using the nonrelativistic function $f(Z,\eta)$ corrected for relativistic effects according to the table of Feister (Phys. Rev. 78, 375(1950)). This was then converted to the energy distributions N(w)W dW and N(W) dW versus W, and the areas under these curves were measured with a planimeter. The ratio of areas gives a mean energy for K^{40} β rays of 0.605 ± 0.010 Mev, somewhat higher than the older value, 0.49 ± 0.06 Mev, listed by Marinelli, Brinckerhoff, and Hine (Revs. Modern Phys. 19, 25(1947)). The total heat production using the revised β- and γ-ray-energy values and Sawyer and Wiedenbeck's emission rates is readily computed to be $(27 \pm 1) \times 10^{-6}$ cal/g of K/yr. This may be compared with $(22 \pm 3) \times 10^{-6}$ cal/g of K/yr calculated by Graf (Phys. Rev. 74, 831(1948)) from earlier data.

2948

Brookhaven National Lab.
ON THE SYSTEMATICS OF EVEN-EVEN ALPHA EMITTERS. Irving Kaplan. [nd.] 32p. (AECU-1151)

The systematics of even-even α emitters are studied. Empirical relationships are found of the form $\log \lambda = a + b/v$, Z constant, for values of Z = 84, 86, 88, 90, 92, and 94. For these cases, the relationships found represent a more precise empirical correlation of α-energy and disintegration constant than does the Geiger-Nuttal rule. Relationships of the form $\log \lambda = A + B/v$, $(A-2Z)$ constant, are found for members of different partial radioactive series and are related to the disintegration schemes of the Th and U families. Values of the nuclear radii and internal potentials are calculated from the rigorous form of the Gamow-Condon-Gurney theory. The radii of "normal" even-even α emitters can be represented by $r_0 = 1.57A^{1/3} \times 10^{-13}$ cm, and the internal potential U, can be represented by $E - U = 0.52$ Mev. The latter relationship is an indication of the approximate constancy, for the different nuclei, of the logarithmic derivative of the radial wave function at the boundary of the nucleus. The empirical relations $\log \lambda = a + b/v$, Z constant, are compared with theory, and the significance of the comparison is discussed. The values of the half-lives of Th^{224}, Ra^{220}, and Em^{216} are predicted. The isotopes of Po and emanation, which show departures from "normal behavior," are considered. (auth)

2949

Brookhaven National Lab.
MEASUREMENT OF ISOMERIC TRANSITION ENERGIES WITH A SCINTILLATION SPECTROMETER. E. der Mateosian and M. Goldhaber. Jan. 30, 1951. 6p. (AECU-1197)

A series of measurements of isomeric transition energies carried out with the help of a NaI (Tl) crystal scintillation counter is reported. The results are summarized as follows:

Isomer	Half-life	Energy of γ, kev
Sc^{46m}	19.5 sec	135
Se^{77m}	17.5 sec	150
Rh^{104m}	4.7 min	52
Sb^{122m}	3.5 min	68
Hf^{179m}	19	215
Ir^{192m}	1.5 min	Continuum

These energy values are estimated to be accurate to 10%. The only serious discrepancy between the present values and the earlier ones appears in the case of Hf^{179m} (19 sec) where Hole (Arkiv Mat. Astron. Fysik 34A, No. 9 (1948)) had found a transition energy of 150 kev with a β-ray spectrograph. The present value is considerably higher (215 kev). The possibility that a two-step isomeric transition exists is being investigated. The apparent γ-ray continuum, previously found for Ir^{192m} (1.5 min) in competition with the 57.4-kev internally converted transition, yields a pulse distribution with an upper limit close to this energy but of very different appearance than that obtained for γ rays of other isomers of similar excitation energy. This spectrum is being investigated further.

2950

Pupin Physics Labs., Columbia Univ.
BETA-SPECTRA OF GASEOUS A^{41} AND O^{15}. Harold Brown and Victor Perez-Mendez. June 15, 1950. 7p. (CUD-38)

The report is a reprint from Phys. Rev. 78, 649-55(1950). A magnetic semicircular focusing spectrometer with a radius of curvature of 13.6 cm has been constructed and adapted for the measurement of the β-ray spectra of emitters in gaseous phase. The radioactive gases were produced by deuteron bombardment of gaseous samples in a cyclotron using special probes. A^{41} (109 min) produced by the $A^{40}(d,p)$ reaction showed a spectrum of maximum energy (1.245 ± 0.005) Mev and an allowed spectrum shape down to at least 200 kev. The half-life of O^{15}, produced by the $N^{14}(d,n)$ reaction, was determined to be (118.0 ± 0.6) sec. The end point of its positrons was (1.683 ± 0.005) Mev. The Fermi plot departed from linearity at 300 kev, but this effect may be of experimental origin. (auth) (This report combines the information given in AECD-2490 and AECU-449 which were abstracted in Nuclear Science Abstracts as NSA 2-1435 and 3-1748.)

2951

Oak Ridge National Lab.
RADIOACTIVITY STUDIES, p.12-31 of QUARTERLY PROGRESS REPORT FOR PERIOD ENDING SEPTEMBER 20, 1950; PHYSICS DIVISION. Jan. 8, 1951. 20p. (ORNL-865 (p.12-31))

The method of delayed coincidences between scintillation detectors employing anthracene and 5819 photomultipliers has been extended to measure time intervals in the region 5×10^{-10} to 1×10^{-8} sec. A block diagram of the apparatus is shown. An excited state in Eu^{153} with a half-life of $(3.0 \pm 0.3) \times 10^{-9}$ sec has been observed with the delayed-coincidence scintillation spectrometer. Sm^{153} (47 hr) is known to decay by a 0.78-Mev β-ray branch leading to an excited state of Eu^{153}. This state is de-excited by γ-ray transitions in cascade corresponding to 69 and 103 kev which are strongly converted. The number coincidences are plotted as a function of delay time obtained with a source of Sm^{153}. This delayed-coincidence resolution curve was recorded by exciting one channel of the delayed-coincidence apparatus by the nuclear β rays and the other channel by the L, M, or N internal-conversion electrons of the 103-kev γ rays. The half-life of the 80-kev transition in Er^{166} has been measured as $(1.7 \pm 0.2) \times 10^{-9}$ sec. The number of coincidences as a function of delay time obtained with a source of Ho^{166} has been plotted. This delayed-coincidence-resolution curve was recorded by exciting one channel of a delayed-coincidence apparatus by 600- to 900-kev nuclear β rays and the other channel by the L, M, or N internal-conversion electrons of the 80-kev transition. Photographs are included of the oscilloscope patterns from proportional counter–spectrometer investigations of x rays emitted by 16 radioactive nuclei. The origin and energy of the lines seen in the photographs are listed. Kurie plots obtained with a split-crystal scintillation-spectrometer unit do not show much of the turnup at low-electron energies which characterize the single-crystal spectrometer and which would be acceptable on magnetic instruments. The β spectrum and the Kurie plot obtained using a P^{32} source, which was thin but was mounted on 100 $\mu g/cm^2$ Formvar-polystyrene film and covered by a similar film, are shown. The split-crystal scintillation spectrometer was applied to a very old cadmium sample. The sample was chemically separated from Ag, Sn, In, Fe, and Co. The spectrum was found to be complex with an inner β group at 350 kev and the outer group at 580 kev. About 20% of the disintegrations are involved in the inner group. A typical Kurie plot is shown. Tests of very large crystals as total-absorption scintillation spectrometers have

been made. A 4-in.-diam 2-in.-thick NaI-Tl crystal was tested, and the resolution was found to be poor. Its failure was attributed to poor activation, since the pulses are also rather small (20% of the height produced by small crystals). A crystal 3 in. in diameter and 3 in. high gives much better results. A central hole 1¾ in. deep and ½ in. in diameter allows samples to be inserted into the crystal. Response to the 0.661-Mev γ ray of Cs^{137} is plotted. The peak contains 0.6 of all the counts. To show the use of the total-absorption spectrometer in decay-scheme determination, a sample of Co^{60} was run. A curve is shown for a source inside the crystal, and another curve is shown for a larger source outside. The two γ rays of Co^{60} at 1.16 and 1.32 Mev are unresolved, but a strong peak at 2.5 Mev can be seen for the first curve. A single-channel analyzer has been built for measuring the pulse spectrum from proportional and scintillation counters. This analyzer has the advantage of using fewer tubes and components than previous models. A circuit diagram of the analyzer is shown.

2952

Radiation Lab., Univ. of California
THE HALF LIFE OF AcC′. (abstract) E. Segrè, N. Spiess, and R. Leininger. Dec. 15, 1950. 1p. (UCRL-1042)

The report is reproduced here in its entirety.

Bombardment of Pb with 20- to 40-Mev α particles gives rise to several short-lived α activities. Of these AcC (Bi^{211}) and AcC (Po^{211}) have been positively identified. A third one is due to an isomer of Po, most probably 211 or perhaps 210. AcC′, contrary to the old assumption based on Geiger-Nuttal law, has a half-life of 0.52 sec. This has been found by producing AcC′ with an (α,n) reaction on Pb^{208} and confirmed by separating it from its mother substance At^{211}, which had been prepared by a $Bi(\alpha,2n)$ reaction by volatilization from a Pt strip. The residue, isotopic with Po, decayed with a half-life of 0.52 sec. We saw also the corresponding increase in α activity of At^{211}, deprived of AcC′, which occurs while the latter substance regrows to reach radioactive equilibrium with At^{211}.

2953

Radiation Lab., Univ. of California
ALPHA DECAY ENERGIES OF POLONIUM ISOTOPES. D. G. Karraker, A. Ghiorso, and D. H. Templeton. Jan. 17, 1951. 18p. (UCRL-1091)

Two new neutron-deficient isotopes of polonium, Po^{200} and Po^{201}, have been identified in Bi bombarded with 150-Mev protons. Mass assignments of these activities were made by successive separation of the electron-capture daughter activities. α-particle energies of these and improved α-particle energies of Po isotopes of mass 206 to 209 have been measured on the 48-channel differential pulse analyzer. The following tabulation is given:

Po^{201}	18 min	5.70 ± 0.03	5.82
Po^{202}	52 min	5.59 ± 0.03	5.70
Po^{203}	47 min	(Not yet observed)	
Po^{204}	3.8 hr	5.37 ± 0.02	5.48
Po^{205}	1.5 hr	5.21 ± 0.10	5.31
Po^{206}	9 days	5.21 ± 0.02	5.31
Po^{207}	5.7 hr	5.10 ± 0.02	5.20
Po^{208}	2.93 yr	5.10 ± 0.02	5.20
Po^{209}	~200 yr	4.86 ± 0.02	4.95
Po^{210}	138 days	5.298	5.40

2954

ARTIFICIAL CHAINS COLLATERAL TO THE HEAVY RADIOACTIVE FAMILIES. W. W. Meinke, A. Ghiorso, and G. T. Seaborg. Phys. Rev. 81, 782-98(1951) Mar. 1. (See also NSA 1-835)

A number of heavy α-particle-emitting nuclides, members of decay chains which are "collateral" to the heavy radioactive series, has been observed, and their radioactive properties have been characterized. Some of these undergo branching decay by orbital-electron capture. The parent isotopes are produced in bombardments of Th with high-energy deuterons or He ions in the 184-in. cyclotron. Chemical identification has been made in all cases where needed, and α-particle energies have been measured through the use of an α-pulse-analyzer apparatus. The following are the collateral series which have been studied: $Pa^{226} \rightarrow Ac^{222} \rightarrow Fr^{218} \rightarrow At^{214}$ (4n + 2 mass type); $Pa^{227} \rightarrow Ac^{223} \rightarrow Fr^{219} \rightarrow At^{215}$ (4n + 3); $Pa^{228} \rightarrow Ac^{224}$ $Fr^{220} \rightarrow At^{216}$ (4n); $U^{228} \rightarrow Th^{224} \rightarrow Ra^{220} \rightarrow Em^{216}$ (4n); $U^{229} \rightarrow Th^{225} \rightarrow Ra^{221} \rightarrow Em^{217}$ (4n + 1). (auth)

2955

COMPLEX β DECAY OF Rb^{88}. Klaus Geiger. Z. Naturforsch. 6a, 54-5(1951) Jan. (Note; in German)

The existing data on the decay of Rb^{88}, an isotope obtained by irradiating Rb^{87} with slow neutrons, are old and incomplete. A new and detailed study of this transformation of Rb^{88} into Sr^{88} revealed complex branchings. Three β emissions, of maximum energies 5.10 ± 0.10, 3.8 ± 0.5, and 1.8 ± 0.2 Mev with a branching ratio 5:2:2, were measured; the first ends in a ground state, but the others are accompanied by γ emissions, the 1.8-Mev decay being followed by a cascade of two quanta. The measurement of the quanta by the coincidence method furnished a mean energy value of 2.2 Mev. The excited levels of Sr^{88} obtained from these findings are 3.3, 2.0, and 1.3 Mev.

2956

THE DISINTEGRATION OF As^{77}. Robert Canada and Allan C. G. Mitchell. Phys. Rev. 81, 485-6(1951) Feb. 1. (Letter to the editor)

An investigation has been made of the radiation of As^{77} obtained by the irradiation of GeO_2 in the Oak Ridge pile. The As was separated from the Ge by a procedure similar to that of Arnold and Sugarman (J. Chem. Phys. 15, 703 (1947)). No initial conversion lines were found in a magnetic-lens-spectrometer investigation of As^{77} which could be attributed to Se^{77m}, thus signifying that As^{77} is not the parent of Se^{77m} and that the transition takes place from the ground state of As^{77} to the ground state of Se^{77}. The experiments lend support to the view that in Se^{77} the $p_{1/2}$ state lies lower than the $g_{9/2}$ state.

2957

THE HALF-LIFE OF CARBON 14. George G. Manov and Leon F. Curtiss. J. Research Natl. Bur. Standards 46, 328-33(1951) Apr.

The half-life of C^{14} has been determined by gas counting of $C^*O_2 + CS_2$ mixtures (where C^*O_2 is used to designate inert carbon dioxide containing some $C^{14}O_2$) by using pairs of counters that are identical in construction except for the length of the cathodes. The suitability of various equations proposed for calculating the true counting rate, C_T, from the resolving time, t_r, and the observed counting rate, C_o, is evaluated from experimental measurements of C_o and t_r and is presented graphically. A value of 5370 ± 200 yr for the half-life of C^{14} is obtained from these measurements. By comparison with the results of other workers, it is estimated that the most probable value for the half-life of C^{14} is 5400 ± 200 yr.

2958

HALF-LIFE OF K^{40}. F. G. Houtermans, O. Haxel, and J. Heintze. Z. Physik 128, 657-67(1950) Dec. 7. (In German)

Using a counter whose geometry covered the entire 4π solid angle, the β activity of natural potassium was found to be equal to 27.1 ± 1.5 β particles/g of K/sec. For the γ activity measured with a counter that had been calibrated with Na^{24} and Co^{60}, the value 3.1 ± 0.3 γ quanta/g of K/sec was determined. Arguments are presented in favor of a decay scheme suggested by Suess, according to which one quantum is emitted at each K capture. These considerations lead to the value $1.33 \pm 0.08 \times 10^9$ yr for the half-life of K^{40}; the rate of production of argon is 3.1 atoms of A^{40}/g of K/sec, or 3.6×10^{-12} cm^3 A/g of K/yr. (auth)

2959

THE IDENTIFICATION OF W^{183} FORMED IN NUETRON-ACTIVATED TUNGSTEN BY A CHEMICAL SEPARATION OF Re^{183}. Manfred Lindner and James S. Coleman. J. Am. Chem. Soc. 73, 1610-11(1951) Apr.

A new radioisotope of tungsten, W^{185}, which was formed by successive neutron capture by the heaviest stable tungsten isotope, W^{186}, has been indirectly established in the presence of very large levels of other radiotungsten isotopes. This was accomplished by observing the activity of the Re^{183} which arises as a result of the decay of the W^{185}. The chemical method consisted in precipitation of the W as oxide and isolation of the Re as tetraphenylarsonium perrhenate. The equilibrium level of separable Re activity was found to diminish with a half-life of 65 days, which is thus the half-life of the W^{185}. The isolation of the Re^{183} in pure form led to a new value of the half-life of this isotope of 16.9 hr as contrasted to previous values of 18 to 18.9 hr. (auth)

2960

L EMISSION SPECTRUM OF THE TRANSMUTATION RaD → RaE. Marcel Frilley, Bhaskar G. Gokhale, and Manuel Valadares. Compt. rend. 232, 157-9(1951) Jan. 8. (In French)

The lines of the L spectrum produced by RaD (Pb^{210}) → RaE (Bi^{210}) as previously determined (Frilley et al., Compt. rend. 231, 50(1950)) are compared in relative intensity with Bi x rays. Assignment of lines to given transitions is discussed in some detail.

2961

Columbia Univ.
LIGHT PARTICLE INVESTIGATIONS, sect. VI of PROGRESS REPORT; NUCLEAR PHYSICS LABORATORIES. J. R. Dunning, Director. Sept. 30, 1950. 13p. (CUD-61(sect. VI))

The β spectrum of Tc^{99} has an α-type spectrum from the end point (293 ± 5 kev) down to 120 kev with a rise below this energy. The β spectrum of Rb^{86} has an end point of 665 ± 10 kev and a tentatively allowed spectral shape. The vacuum evaporator was modified and used to prepare sources of Rb^{86} and P^{32}. β-γ angular correlation measurements are being carried out on high-specific-activity specially purified Rb^{86} and on Sb^{124}. Construction and design of equipment, based on a survey of the problem involved in the measurement of millisecond isomerism, has been initiated. The production rate of He^6 for the neutrino experiment has been increased twofold, and further work is in progress to determine whether Be metal may be used in the He^6 production instead of the present $Be(OH)_2$. The ratio of neutrons available in the forward direction to those available in the backward direction was measured. The most efficient pulsing time and duty cycle of the cyclotron in producing He^6 for the neutrino experiment were determined. The single-channel pulse-height analyzer is being used in tests on the β-scintillation spectrometer with an anthracene crystal. The β spectrum of F^{17} shows two groups of electrons both exhibiting the allowed shape with end points of 1.72 ± 0.03 and 0.78 Mev and with the lower group 33 ± 5% as abundant as the upper group. Absorption measurements on the γ ray yield an energy of 0.98 ± 0.05 Mev and a half-life in good agreement with that of F^{17}. The method of taking measurements in the presence of a 10-min positron activity is discussed. A theoretical interpretation of the transitions is given. A shielded chamber for taking absorption curves, using an anthracene crystal to determine the energy of γ rays, was made and tested on the annihilation and γ radiation of Na^{22}.

2962

NATURAL β-RAY SPECTRUM OF RaC. Mitsuo Miwa and Seizaburo Kageyama. J. Phys. Soc. Japan 5, 416-21(1950) Nov.-Dec.

The β-ray spectrum of RaC has been examined with particular reference to the intensity of conversion line K1379 kev (where K denotes the electron shell of the atom where conversion of the 1379 kev γ ray takes place) and also of K1414, L1414, and M1414. Discrepancies with previous experimental work in the same field are discussed.

2963

NATURALLY OCCURRING RADIOACTIVITY IN SOME ORGANIC AND INORGANIC AGRICULTURAL MATERIALS. I. METHOD OF DETECTION AND RESULTS. Helge Bergh. Kgl. Norske Videnskab. Selskabs Forh. 23, No. 5, 16-20 (1950) June 25.

Results of measurements of radioactivity on a pure potassium salt (KCl) with two different TGC-2 end-window G-M counters at various distances are reported. Results of similar measurements on a pure uranium salt ($UO_2(NO_3)_2 \cdot 6H_2O$) and on Zn^{65} are included.

2964

NEPA Div.
SCINTILLATION SPECTRA OF ARSENIC^{76}. Joe Keagy Bair and Fred Malenschein. Nov. 1, 1950. 6p. (NEPA-1620)

Radioactive As^{76} was prepared by thermal-neutron bombardment of arsenic trioxide. The resulting activity had a half-life of 27.6 ± 1 hr with no indication of the presence of any other period. The spectra obtained with a single 1-in. NaI crystal are shown. Further investigation of the spectra was made with a Hofstadter-type two-crystal spectrometer. The two-crystal spectra clearly indicate the presence of four γ rays. The γ-ray energies were calculated from the observed recoil-electron energies and with the known degraded crystal geometry. If there is a crossover ray of between 2.3 and 2.7 Mev, its intensity must be less than 10^{-4}.

2965

SPECTROGRAPHY BY CRYSTALLINE DIFFRACTION OF THE ELECTROMAGNETIC RADIATION OF RaD. Marcel Frilley, Bhaskar G. Gokhale, and Manuel Valadares. Compt. rend. 232, 50-2(1951) Jan. 3. (In French)

The γ rays and internal-conversion L x rays of RaD (Pb^{210}), as observed with a bent-crystal spectrograph and various sensitive emulsions, are listed. Analysis and theoretical interpretation of these results will be given in a later note.

2966

THE TRANSITION SCHEME $Hf^{181} \rightarrow Ta^{181}$. PRELIMINARY DISCUSSION. Arne Lundby. In Forsvarets Forskningsinstitutt, Årbok II, 1948-49, 47-60.

The decay scheme of Hf^{181} produced in the reaction $Hf^{180}(n,\gamma)Hf^{181}$ is discussed. Hf^{181} emits β^- particles of 0.45-Mev maximum energy. The resulting metastable state of Ta^{181} has a half-life of $(20.1 \pm 0.7) \times 10^{-6}$ sec, the transition to the ground state taking place in two steps, of 0.13 and 0.5 Mev, in "instantaneous" succession. The spin of the ground state of Ta^{181} being 7/2, that of the 0.5-Mev state is probably 7/2 or 5/2, and that of the metastable state is 1/2 or 3/2. The parity of the 0.5-Mev state is the same as that of the ground state, and that of the metastable level is opposite to it. The ground state of Hf^{181} must have a spin 1/2 or 3/2 and the same parity as the ground state of Ta^{181}.

RARE EARTHS AND RARE-EARTH COMPOUNDS

2967

DILATOMETRIC STUDY OF METALLIC NEODYMIUM. Félix Trombe and Marc Foex. Compt. rend. 232, 63-5 (1951) Jan. 3. (In French)

From −195 to 650°C, Nd does not show any transformation accompanied by an important volume change. This is contrary to the situation for Ce, which has an abnormal dense form, attributed by the authors to passage of a 4f electron to a valence orbit, below −164°C (descending temperature). The following values of the coefficient of expansion of Nd are given: 6.6×10^{-6} (−195 to 0°C); 7.4×10^{-6} (0 to 200°C); 7.8×10^{-6} (200 to 400°C). Thus Nd, like Ce and La, has a coefficient of expansion abnormally small for a relatively low-melting metal (m.p. = 840°C).

SPECTROSCOPY

2968

Office of Naval Research, London
SPECTROSCOPY AND MOLECULAR STRUCTURE, CAMBRIDGE, ENGLAND, SEPTEMBER 25–28, 1950. George J. Szasz. Oct. 30, 1950. 20p. (ONRL-106-50)

The broad field of spectroscopy and molecular structure was one of the topics of the general discussion held by the Faraday Society in Cambridge on September 25-28, 1950. This discussion actually dealt with two topics: (1) molecular spectroscopy and (2) optical methods of investigating cell structure. The first topic was divided into three parts: (1) electronic spectra, (2) vibrational and rotational spectra of simple molecules, and (3) vibrational spectra of complex molecules. In this report, which deals only with the spectroscopy section of the discussion, an account of some of the papers and discussions is given. The complete program of the spectroscopy discussion is found in an appendix.

THEORETICAL PHYSICS

2969

BOUNDARY CONDITIONS FOR THE DESCRIPTION OF NUCLEAR REACTIONS. Marcos Moshinsky. Phys. Rev. 81, 347-52(1951) Feb. 1.

The present paper deals with a phenomenological description of nuclear reactions by means of boundary conditions. The several stages of the reaction (initial particles, compound nucleus, etc.) are described in their respective configuration spaces; and the state representing the entire system is given by a wave function in Fock space. The wave equations and the boundary conditions are deduced with the help of an analogy to vibration problems. The interaction leading to the nuclear reaction appears as a boundary condition between the different components of the Fock-type wave function. A discussion is given of elastic scattering and of two-particle nuclear reactions, showing that the present procedure gives the same dependence of the cross sections on energy as the Breit-Wigner resonance formula and its generalizations. A sketch is given of the extension of the present ideas to multiple-particle reactions. The whole treatment is nonrelativistic. (auth)

2970

ON HUYGENS' PRINCIPLE FOR ELECTROMAGNETIC WAVES. Gunnar Randers. In Forsvarets Forskningsinstitutt, Årbok 1947, 6-12.

Huygens' principle, which is formulated for a scalar field, does not satisfy Maxwell's equations when applied to the components of electromagnetic vectors. However, if point sources are replaced by electric and magnetic dipoles, Huygens' principle becomes applicable to the electromagnetic field.

2971

ON THE INTEGRABILITY CONDITION IN THE SUPER-MANY-TIME THEORY. Kazuhiko Nishijima. Progress Theoret. Phys. (Japan) 5, 187-95(1950) Mar.-Apr.

While avoiding certain ambiguities of the ordinary one-time theory, the super-many-time method does not generally lead to any new results. A case is examined where, by applying the latter theory, a result is obtained that is beyond the reach of the one-time theory, viz., a rule for choosing between various decay types. A discussion of the possible structure of the Hamiltonian density shows that, in the method under consideration, the integrability condition is imposed, besides mathematical reasons, by the energy and momentum conservation requirements.

2972

A QUANTUM THEORY FOR NUCLEAR FORCES. M. A. el Nadi. Proc. Math. Phys. Soc. Egypt 4, 35-9(1949) May.

Assuming de Broglie's theory for particles of spin 1, the author develops a modified set of wave equations for the description of such particles (mesons and photons). It is shown that two expressions could be derived for the probability density-current vector and the energy-momentum tensor. Both expressions for the probability density have positive and negative values related to particles with positive and negative energies, respectively. (auth)

2973

RELATIVITY PHYSICS. W. H. McCrea. New York, Wiley; London, Methuen, 1950. Third Edition. 87p. + vii.

"Relativity Physics" treats of "special relativity" only. It is presented as a mathematical text for physicists and makes use of elementary mathematical methods without any recourse to tensor calculus. The general formulas of special relativity are derived for the fields of mechanics, optics, electromagnetic theory, atomic physics, thermodynamics, statistical mechanics, and hydromechanics. Background information on the importance and use of the Lorentz transformation is given. A more complete review by J. Rand McNally, Jr., may be found in J. Optical Soc. Am. 41, 140(1951) Feb.

2974

STATISTICAL EQUILIBRIUM AND RADIATION DAMPING. J. Hamilton. Phys. Soc. (London) 63A, 1036-40(1950) Sept. 1.

The reason why the usual form of radiation damping theory for the scattering, creation, or annihilation of mesons does not satisfy the principle of detailed balancing is discussed. A form of damping theory satisfying statistical equilibrium is developed.